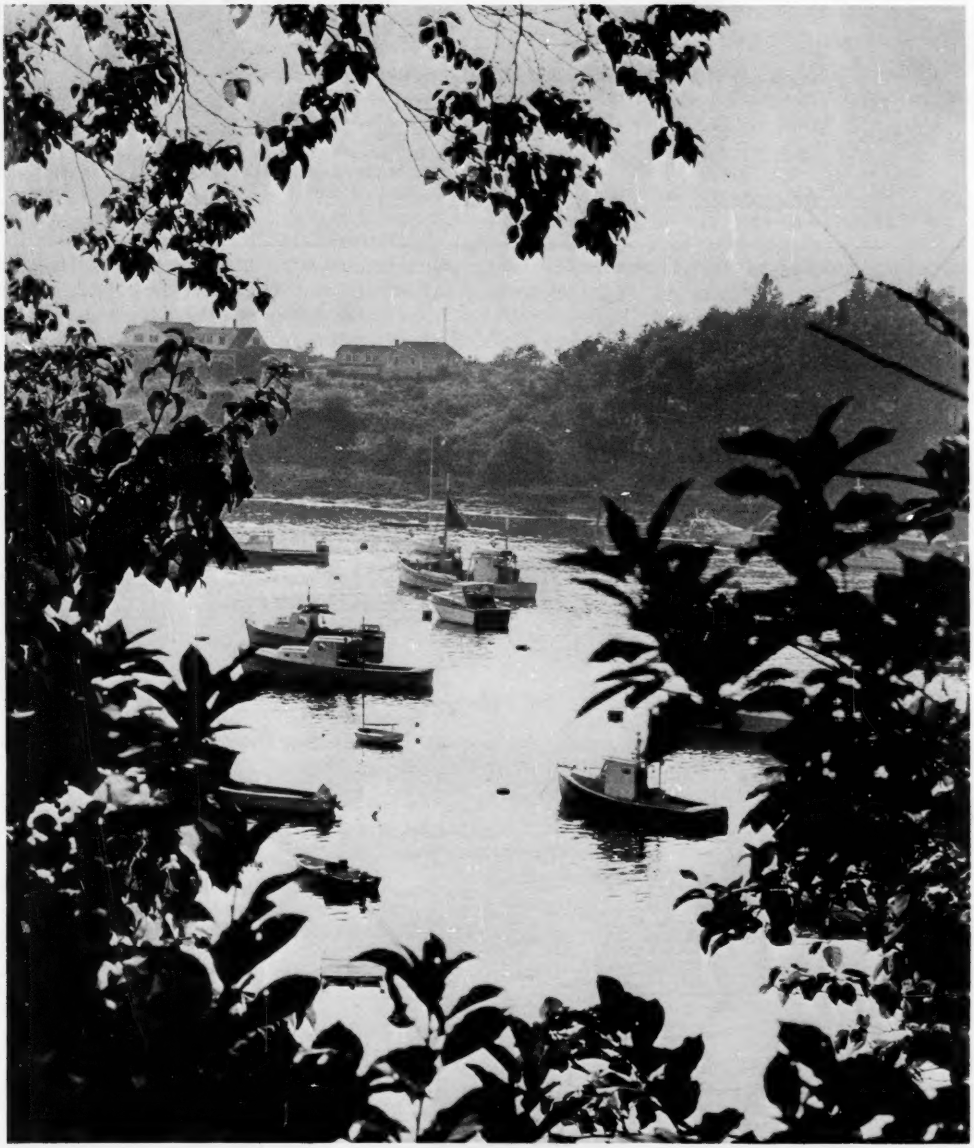
Marine Fisheries REVIEW

January 1982
Vol. 44, No. 1

National Oceanic and Atmospheric Administration • National Marine Fisheries Service



The Value of Maine's Fisheries

Marine Fisheries REVIEW

Mackerel Cove, Maine, photograph courtesy of the Department of Marine Resources, Augusta. See the article beginning on page 1.

January 1982, 44(1)

Articles

Departments

U.S. DEPARTMENT OF COMMERCE

Malcolm Baldrige, Secretary

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

John V. Byrne, Administrator
William G. Gordon, Assistant Administrator for Fisheries

National Marine Fisheries Service

Editor: W. Hobart

Marine Fisheries Review (USPS 090-080) is published monthly by the Scientific Publications Office, National Marine Fisheries Service, NOAA, 7600 Sand Point Way N.E., Bin C15700, Seattle, WA 98115.

Single copies and annual subscriptions are sold by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. Prices are: Single copy, \$3.25 domestic, \$4.10 foreign; annual subscription, \$18.00 domestic, \$22.50 foreign. Copies of individual articles, in limited numbers are available from D822, User Services Branch, Environmental Science Information Center, NOAA, Rockville, MD 20852. News items are not reprinted.

Second class postage paid at Finance Department, USPS, Washington, DC 20260.

An Input-Output Analysis of Maine's Fisheries

HUGH BRIGGS, RALPH TOWNSEND, and JAMES WILSON

Introduction

Since the passage of the Fisheries Conservation and Management Act of 1976, the New England fishing industry has experienced a substantial revitalization. Maine, perhaps even more than the rest of New England, has rapidly expanded its harvesting and processing sectors. This favorable environment has generated renewed interest in the impact of fisheries on the local economy. In Maine's case, the State has undertaken pier construction and market development activities based in part upon expected, but quantitatively unknown, benefits to the State's economy. This paper presents an input-output model to estimate the impact of fisheries activities on the Maine economy.

Economic activity is a complicated web of interdependent behavior. A change in any part of the economy leads to changes elsewhere. Consequently, estimation of the ultimate total impact of a change in marine harvesting or processing requires measurement of the changes that occur elsewhere in the economy. In other words, the economic importance of the fishing industry depends upon the relationship of fishing to the rest of the economy.

One technique available to obtain these measurements is called input-output analysis[1]. Input-output is basically a massive accounting system which records the sales of each industry to every other industry and to final consumers. With the help of a computer program, this accounting system can be used to trace the connections between all industries in the economy.

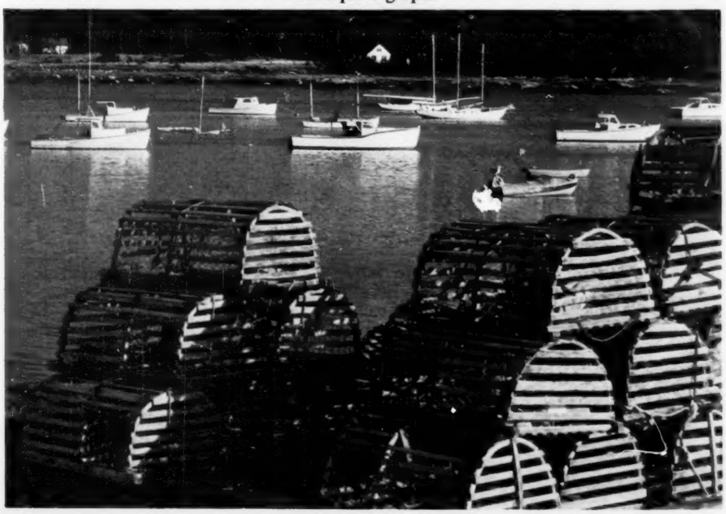
In the last decade, regional input-output models have been constructed from census data gathered by the Federal government. These models are now

ABSTRACT—An input-output model of Maine's economy, modified to include nine fisheries sectors, was used to estimate the increases in income induced per dollar of sales for each fisheries sector. Based on these figures, it was estimated that Maine's 1980 landings, valued at $90 million, ultimately generated $240 million in income in Maine.

[1]For a very clear explanation of the mechanics of input-output modelling, the reader is referred to Miernyk (1965). Chapters 2 and 3 of Miernyk thoroughly explain construction and application of input-output models. Chapter 4 on regional models is especially appropriate to the present analysis. Dorfman et al. (1958, chapters 9, 10) is more mathematical, but discusses the underlying assumptions more thoroughly.

Hugh Briggs is a research associate, Ralph Townsend is an assistant professor, and James Wilson is a professor with the Department of Economics, University of Maine at Orono, ME 04469. For 1980-81, James Wilson was a Fellow in Marine Policy and Ocean Management at Woods Hole Oceanographic Institute, Woods Hole, MA 02543.

Lobster traps at Round Pond harbor in Maine. State of Maine Development Office photograph.



frequently used to analyze the impact of government policies upon state economies. None of the existing models, however, contain detailed fisheries sectors. Most often, fisheries are included with forestry or agriculture. The present analysis modified one of these aggregated models of Maine's economy to include nine fisheries sectors. The model was further modified to calculate income flows, as well as transactions. This fisheries-oriented model of Maine's economy was then used to estimate income multipliers for each fishing industry.

A Regional Input-Output Approach

Input-output analysis provides a simple general equilibrium approach to quantitative economic analysis. An increase in the output of one sector increases the demand for output in its supplying industries, and in industries which supply the suppliers, and so on. Intuitively, an input-output model calculates an infinite series of such supplying relationships. For any set of desired net outputs by an economy, the model calculates the total production required of each industry. Hence, it is called a general equilibrium approach.

To obtain general equilibrium answers with a minimum of data requirements, input-output analysis depends upon very strong technological assumptions. Each unit of output (measured in dollars) requires fixed proportions of inputs from every other industry. For example, one dollar's worth of steel might always require five cents of iron ore, three cents of coal, and so on. An economy could satisfy this assumption if the following were all true:

1) There is only one primary input, usually labor.

2) The technology is homogenous of degree one. This implies constant returns to scale along all expansion paths.

3) The technology does not change.

4) Production of each output is separable from production of all other products. This assumption rules out joint products.

If there are two or more primary inputs, the technology must be further restricted to a fixed coefficients production function. The elasticity of technical substitution is zero in this case. Either set of assumptions can only be approximately true in a real economy. These fixed coefficients are estimated from actual transactions in a base year.

In a national input-output model with no foreign sector, all demands are supplied by industries within the national economy. In a regional economy, substantial trading between the region and the rest of the economy will occur. The extent of this trading will determine whether the economic benefit of increased activity remains in the region or flows out to the rest of the economy. These flows in and out of the region must be incorporated into a regional model. For example, in the steel example, a regional model must differentiate between iron ore from within the region and iron ore from the rest of the economy.

This differentiation is based upon actual transactions in the base year. Products are divided into two classes: products which Maine imports on net, and products which Maine exports on net. For products which Maine imports, we assumed the ratio of in-state production to total demand to be constant. That is, out-of-state sources provide a fixed percent of total demand. This assumption is consistent with the fixed coefficients approach of input-output models.

For products which Maine exports on net, all in-state demands are met by in-state production. All changes in demand are absorbed by in-state suppliers. Sales to out-of-state purchasers are exogenous, and do not change as in-state economic activity changes.

For arbitrary changes in fisheries outputs, the input-output model of Maine's economy will estimate the change in output of every Maine industry. These production estimates are often very useful for planning decisions. However, the present analysis is primarily concerned with estimating the total impact of fishing activities upon the economic welfare of Maine citizens. Total output is not a good indicator of economic welfare. A large part of total output in Maine originates outside the State, and so does not generate employment within the State. Also, the percent of total value originating in-state varies from one sector to another. For example, gasoline sales of one dollar generate far less income in Maine than equivalent sales of haircuts. Therefore, we need a better measure of welfare than total sales.

Input-output models can also generate estimates of changes in consumption and income. As a measure of economic welfare, either of these is preferable to estimates of total production. That is not to suggest that income or consumption are perfect measures of welfare. Estimates of changes in income or consumption ignore many important aspects of economic welfare. For example, reductions in leisure, natural resource depletion, and social disamenities are all excluded from the monetary accounting system. While there are techniques which incorporate some of these factors into input-output models, such refinements are beyond the scope of the present work.

The relevant choice here is whether to approximate economic welfare by consumption or by income. Taxes and savings are the major differences between income and consumption. Savings are usually a voluntary alternative to consumption, and therefore must increase individual welfare. Taxes support government activities, and most people would agree that these activities provide at least some benefit to society. Consumption probably understates economic welfare; income may err in the other direction. If we are interested in relative changes, the distinction is not important anyway. Consumption and income increase proportionately in a fixed coefficients input-output model. Economic analyses, and especially those done for economic development purposes, invariably emphasize income, and we have followed that convention.

Income within each industry is measured by value added, which is the difference between gross sales and total purchased inputs. Value added as a measure of state income has a weakness. The percent of the value added which flows to households outside the state is unknown. We have assumed that all value added remains within the State. For labor income (which accounts for

75-80 percent of personal income) this assumption is quite reasonable. For payments to capital and natural resources, however, this assumption is incorrect to some unknown degree.

For analytic purposes, it is useful to separate the income generated into three categories:

1) The "direct effect" of income generated in the fishing industry;

2) the "indirect effect" of income generated by sales of goods and services to the fishing industry; and

3) the "induced effects" which arise when personal income generated directly and indirectly is respent.

To provide separate estimates of direct, indirect, and induced income, two closely related input-output models were used. In the first, consumption expenditures in-state were determined exogenously. This is called an open model. In an open model, increased fishing activity generates income within the fishing industry and within supplying industries. These income changes do not affect the level of consumer purchases. In the second or closed model, changes in income do cause changes in consumption. To summarize, direct plus indirect income is estimated by the open model. Direct plus indirect plus induced income is estimated by the closed model. Direct income is known, so indirect income and induced income can be derived by subtraction.

Both the open and the closed models are developed mathematically in the appendix.

The Data

The transactions, total production, and total consumption data for the open model were from the 1963 U.S. Multiregional Input-Output Model and were measured in thousands of 1963 dollars[2]. Trade with the rest of the economy for 1963 was also derived from this source.

The raw data from these national accounts provided 79 industries. These were aggregated to 28 sectors which were roughly consistent with annual data generated by the State of Maine. After 9 fisheries sectors were added, the open input-output model contained 37 industries.

Even with 79 industries, the transaction data collected by Federal agencies was much too aggregated to provide useful information about fisheries. The fisheries sectors were subsumed into two broader industries: 1) Forestry and fisheries and 2) food processing. To provide the detail necessary for policy analysis in fisheries, the fisheries harvesting and processing sectors had to be removed from these two broad categories and reintroduced into the transactions tables as five separate harvesting sectors and four processing sectors. The harvesting sectors were: Clam harvesting; marine worm harvesting; herring and menhaden harvesting; lobster, crab, and scallop harvesting; and groundfish harvesting. For processing, clam and marine worm processing were lumped together. Otherwise, the processing sectors corresponded to the harvesting sectors: Herring and menhaden processing; groundfish processing; and lobster, crab, and scallop processing.

Purchases for the nine fisheries sectors had to be removed from the very aggregate sectors and then reentered as separate sectors. Based upon estimates for 1963[3], fishery purchases were subtracted from the forestry and fisheries sector (yielding a forestry sector) and from the food processing sector (yielding a food, except fish, processing sector)[4]. Then the nine new sets of purchases were added to the transaction data.

The sales of fisheries products were based upon the estimates cited above. All fisheries sales were to final demand, exports, or to other fisheries sectors. Sales to other industrial sectors were assumed to be zero. The data collected could not distinguish between in-state and out-of-state sales to final consumers. Consequently, the following assumptions were used:

1) No in-state consumption of marine bait worms,

2) consumption of 10 percent of the lobster and clam catch in-state, and

3) consumption of 2 percent of herring and groundfish processing output in-state.

To "close" the model, household sector purchases in the base year must be removed from the final demand vector and entered as the purchases of a new 38th industry, called households. Unfortunately, household purchases for 1963 were unavailable. Instead, Maine consumption expenditures were obtained for 1970. The 1970 consumption expenditures were multiplied by the ratio of 1963 total consumption to 1970 total consumption. Note that, as with any other industry, the pattern of purchases of the household sector in any input-output model is assumed to be constant. Likewise, the ratio of total consumption to total income is constant. This consumption data was the only new data required to close the model.

Results

Table 1 lists the income generated within Maine's economy per dollar of the various fish harvesting and processing activities in the State. To help interpret Table 1, consider an example from the herring fishery. Increasing herring landings by $1.00 leads directly and indirectly to an increase in income in Maine of $0.73 ($0.51 in the herring harvesting sector and $0.22 in all others).

[2]Further details on the construction of State input-output tables may be found in Polenske et al. (1972). The use of 1963 technical coefficients for the nonfisheries sectors of the economy was based solely upon the availability of the data. A new table for 1972 is expected shortly and the estimated impact multipliers can be updated to reflect that new data.

[3]The estimation of input requirements per dollar of sales for fisheries sectors was based upon interviews conducted with industry and government personnel in 1979. Details of this estimation are contained in J. Wilson, T. Duchesneau, H. Briggs, B. Burlingame, K. Rollins, and D. Williams, The economic impact of fisheries in the State of Maine. *In* C. J. Walton (editor), Fisheries management and development: Completion report to the State Planning Office for the period October 1, 1978 to September 30, 1979, Volume IV, Element E. Transactions were estimated by multiplying input requirements per dollar times 1963 fishery sales reported in Lyles (1965).

[4]In some instances the subtraction of fisheries sectors created negative transactions in forestry and food sectors. These transactions were assumed to be zero.

Table 1.—In-state income multipliers for nine fishing industries.

Industry	Direct	Indirect	Induced	Total
Harvesting sector				
Clam	0.57	0.20	0.77	1.54
Worm	0.72	0.10	0.83	1.65
Herring and menhaden	0.51	0.22	0.74	1.47
Lobster, crab, and scallop	0.35	0.34	0.69	1.38
Groundfish	0.29	0.37	0.66	1.32
Processing sector				
Clam and worm	0.24	0.58	0.83	1.65
Groundfish	0.14	0.53	0.66	1.33
Herring and menhaden	0.28	0.31	0.59	1.18
Lobster, crab, and scallop	0.17	0.42	0.58	1.17

Table 2.—Estimated in-state income from nine fishing industries, 1980.

Industry	Gross output	Estimated income
Harvesting sector		
Groundfish	$19,697,000	$26,000,040
Herring and menhaden	6,427,000	9,447,690
Lobster, crab, and scallop	52,670,000	72,684,600
Clams	8,554,000	13,173,160
Worms	2,499,000	4,123,350
Processing sector[1]		
Groundfish	$18,021,000	$23,968,000
Herring and menhaden	56,509,000	66,681,000
Lobster, crab, and scallop	70,872,000	82,920,000
Clam and worm	17,507,000	28,886,000

[1]All processing figures are preliminary estimates based on 1980 reported landings and the proportion of landings to processed value in 1963. Direct, indirect, and induced income are included in estimated income.

Table 3.—Estimated in-state income of processing sectors, excluding fish purchases, 1980.

Processing sector	Gross output	Estimated income
Groundfish	$18,021,000	$ 9,731,340
Herring and menhaden	56,509,000	58,204,270
Lobster, crab and scallop	70,872,000	34,018,560
Clam and worm	17,507,000	11,240,480

This $0.73 of income is responsible, as it is in turn spent on consumption items, for an additional $0.74 of income—the induced income effect[5]. Consequently, the total impact upon income per dollar of herring landings is $1.47.

The income generated per dollar of sales was higher for fisheries than for virtually any other sector in the State. For example, the total income multiplier for wood and paper products, the State's most important industry, is .98. The higher ratio of income to sales for fisheries is explained by two factors. First, many fisheries are relatively more labor intensive, generating greater direct value added. Second, fisheries seem to purchase relatively more of their inputs in-state as compared with other industries. For example, boat building services are a major input which is produced in-state.

The total impact of any one fishery on the Maine economy for 1980 is estimated by multiplying gross output in 1980 times the total income multiplier. These calculations are presented in Table 2.

However, estimating the aggregate impact of all nine fisheries sectors is a bit more complicated than simply adding the columns in Table 2. To the extent that fisheries sectors buy from each other, either directly or indirectly, simply adding the columns in Table 2 would lead to inadvertent double counting. For the five harvesting sectors, this double counting is relatively minor—consisting mostly of bait purchases. Therefore, adding the separate figures for the five harvesting sectors will not be substantially in error. The $90 million in landings for 1980 generated approximately $125 million in income.

The processing sectors purchase their primary input—fish—directly from the harvesting sector. Therefore, estimated income for processing sectors includes income generated by increased purchases of fish. Adding the harvesting income estimates to the estimates for the processing sector will double count income attributable to harvesting. Table 3 presents the estimated impacts of the processing sector exclusive of fish purchases. Processing generated an estimated net addition to income of $113 million in 1980, only slightly less than the income generated in harvesting. Adding the processing sector impacts to the harvesting sector impacts provided an estimated total income of $239 million.

The input-output model also provided detailed information on how various nonfishing industries within the State are affected by fishing activities. Such information may be useful for economic planning activities by the State[6]. The detailed data has obvious political interest as well. Those industries which may gain directly or indirectly from increased fishing activity have an interest in policies which promote the fishing industry.

Tables 4 and 5 present the estimated impact upon selected Maine industries from a $100,000 increase in harvesting or processing activities. These estimates are based upon the open model, and include only indirect effects. Therefore, these industries directly or indirectly supply fishing industries. The numbers in Tables 4 and 5 are rounded to the nearest thousand dollars. The tables include all industries which receive $1,000 or more of income per $100,000 of harvesting or processing activity.

Tables 4 and 5 contain no major surprises. Most of the entries reflect the pattern of direct purchases by fishing industries. The groundfish, herring, and lobster fisheries are major purchasers of boats (included in motor vehicles), nets (fabrics), and gear. The very labor intensive clam and worm digging industries have much less indirect input. The figures for the processing sectors are

[5]Because consumption is a constant percent of income, and because the consumption pattern is fixed, estimated induced income in an input-output model is necessarily a constant proportion of direct and indirect income. However, that that proportion was almost exactly one in this analysis was strictly an empirical accident.

[6]It has been suggested that data on income earned by out-of-state industries might also be useful for planning purposes. Industries which supply fishing activities directly or indirectly could be encouraged to locate here. Perhaps due to our very aggregated definition of industries, this input-output model did not provide very useful information. The major out-of-state purchases were in electrical and mechanical machinery, petroleum, and chemicals. Maine would obviously like to attract some of these industries, but purchases by fishermen and processors will not be a significant factor.

Table 4.—Income generated in selected Maine industries per $100,000 of fishing activity. (In thousands of dollars.)

Nonfishing industry	Harvesting sector: Groundfish	Herring and menhaden	Lobster, crab, scallop	Clam	Worm
Livestock	$2	$2	—	—	—
Wood and paper products	1	1	2	1	1
Maintenance and construction	1	—	1	—	—
Fabrics and misc. textiles	9	7	1	—	—
Engines and machinery	1	1	1	1	—
Motor vehicles	3	4	3	8	6
Transportation and warehousing	5	1	4	—	—
Wholesale and retail trade	3	2	2	1	1
Finance and insurance	9	3	8	3	—
Miscellaneous retail	1	1	5	4	—
Electrical manufacturers	1	1	1	—	—

Table 5.—Income generated in selected Maine industries per $100,000 of fish processing. (In thousands of dollars.)

Nonfishing industry	Processing sector: Groundfish	Herring and menhaden	Lobster, crab, scallop	Clam and worm
Livestock	1	1	—	—
Wood and paper products	3	2	2	2
Maintenance and construction	2	1	—	—
Food and kindred products	—	2	—	—
Fabrics and misc. textiles	5	1	1	—
Metal products	—	1	—	—
Engines and machinery	2	1	1	—
Motor vehicles	2	1	2	5
Transportation and warehousing	4	5	4	1
Utilities	1	3	—	—
Wholesale and retail trade	4	1	2	1
Finance and insurance	6	2	5	2
Miscellaneous retail	3	3	4	3

harder to interpret, but generally seem to reflect purchases by both processors and fishermen.

The large indirect income earned by the finance and insurance and the transportation and warehousing sectors is perhaps the only surprise in Tables 4 and 5. Fishermen who operate boats do spend a large portion of their income on interest and insurance. The relatively large income earned by the transportation and warehousing sector is harder to explain. Maine's remote location perhaps explains the importance of this sector.

We estimate that fisheries-related income accounted for 2.8 percent of Maine's 1980 total personal income of $8.6 billion. These figures emphasize the importance of fisheries activities to Maine's economy. We suspect these estimates have a conservative bias, because a number of smaller fisheries (sea moss, elvers, anadromous species, periwinkles, and sea urchins) are excluded. The analysis is also limited to fisheries per se, and does not include other marine activities such as shipping and recreation.

Acknowledgments

The authors wish to acknowledge the very important work by Blair Burlingame, Thomas Duchesneau, Kimberly Rollins, and Douglas Williams of the University of Maine at Orono on the estimation of fisheries sectors technical coefficients. Financial support was provided through the Maine Department of Marine Resources. This work was conducted as part of the Coastal Program of the Maine State Planning Office, and financial assistance for preparation of this document was provided in part by a grant from Maine's Coastal Program, through funding provided by U.S. Department of Commerce, Office of Coastal Zone Management, under the Coastal Zone Management Act of 1971, as amended. Financial support was also provided by the Pew Memorial Trust and Woods Hole Oceanographic Institute's Marine Policy and Ocean Management Program.

Literature Cited

Dorfman, R., P. Samuelson, and R. Solow. 1958. Linear programming and economic analysis. McGraw-Hill, N.Y., 527 p.

Lyles, Charles H. 1965. Fishery statistics of the United States 1963. U.S. Fish Wildl. Serv., Stat. Dig. 57, 522 p.

Miernyk, W. H. 1965. The elements of input-output analysis. Random House, N.Y., 156 p.

Polenske, K. R., C. W. Anderson, and M. M. Shirley. 1972. A guide for users of the U.S. multiregional input-output model. U.S. Dep. Transportation, Wash., D.C., 201 p.

Appendix: Construction of the Model

Although the two input-output models are conceptually quite different, mathematical application involves essentially identical calculations. The following discussion describes the open model in detail, and then outlines the necessary modifications to "close" the model.

The solution of an input-output model requires data on purchases in some base year by each industry and by final consumers. This data is then manipulated algebraically to construct a linear relationship between final demands and total production of each industry. Based upon this relationship, estimates can be made of income generated by changes in levels of economic activity in various industries. In the present application a 37-industry model of the Maine economy was used. To solve such an input-output model, the following data is required for any single year[7]:

$[TR]$: a 37×37 transactions matrix (one row and one column for each industry). An element $\{tr_{i,j}\}$ represents sales from the ith industry (located anywhere in the United States) to the jth Maine industry.

$\underline{TP}$: a 37-element vector of total production of each industry in Maine. An element $\{tp_i\}$ represents the output of the ith Maine industry.

$\underline{FD}$: a 37-element vector of final demands for the output of each industry. Each element $\{fd_i\}$ is the sum of personal consumption expenditures, State and local government purchases, Federal government purchases, gross private investment, net inventory change, foreign exports, and residual accounting elements (including service industry residuals, scrap and secondary transfers out) by Maine's consumers, businesses, and governments.

$\underline{TC}$: a 37-element vector of total intermediate and final consumption in Maine (whether purchased in or out of the State). An element $\{tc_i\}$ represents total Maine purchases from the ith industry.

From this data, we may derive the following:

$\underline{W}$: a 37-element vector of intermediate purchases by Maine businesses. Intermediate purchases include all goods and services used up in the productive process. Intermediate purchases do not include investment purchases, which are included in final demand. An element $\{w_i\}$ may be calculated as

$$w_i = \sum_{j=1}^{37} tr_{i,j}. \qquad (1)$$

Alternatively, intermediate demand may be derived from the relation among total consumption, final demand, and intermediate demand:

$$tc_i = fd_i + w_i. \qquad (2)$$

Now derive a matrix $[A]$ whose typical element $\{a_{i,j}\}$ is calculated:

$$a_{i,j} = tr_{i,j}/tp_j. \qquad (3)$$

An element $\{a_{i,j}\}$ represents the direct requirements of inputs from industry i per dollar of output of industry j. $[A]$ is called a "technical coefficients matrix." We can then represent $\underline{W}$ as

$$\underline{W} = [A]\,\underline{TP}. \qquad (4)$$

We can also derive a vector of value added coefficients, $\underline{V}$. Value added is the difference between value of output and cost of purchased materials. According to the accounting convention used, value added is the sum of all forms of income. An element $\{v_i\}$ is the percent of the value of total product which becomes income in the ith industry:

$$v_i = 1 - \sum_{j=1}^{37} a_{i,j}. \qquad (5)$$

In a national input-output model, the next step would be to apply the accounting identity that total consumption equals total production for each product. This identity is not true in a regional model. Rather, there may be extensive net purchases from out-of-state firms, or substantial net sales to out-of-state buyers. Consequently, we must introduce vectors of net "exports" or net "imports" exchanged with the rest of the United States:

$\underline{M}$, a 37-element vector of net imports from other States. An element $\{m_i\}$ represents net purchases of the ith product by Maine consumers and businesses from out-of-state firms. For the base year, $\{m_i\}$ is calculated as:

$$\text{if } tc_i > tp_i, \text{ then } m_i = tc_i - tp_i, \quad \text{otherwise, } m_i = 0. \qquad (6)$$

$\underline{X}$, a 37-element vector of net exports of products to consumers and firms in other States. For the base year, an element $\{x_i\}$ is calculated:

$$\text{if } tp_i > tc_i, \text{ then } x_i = tp_i - tc_i, \quad \text{otherwise } x_i = 0. \qquad (7)$$

Let us now define a diagonal matrix $[Q]$. A diagonal element, $\{q_{i,i}\}$, of this matrix is defined:

$$q_{i,i} = m_i/tp_i. \qquad (8)$$

Consequently:

$$\underline{M} = [Q]\underline{TP}. \qquad (9)$$

Now, total production can be related to final demand and exports by algebraic manipulation of the preceding definitions:

$$\underline{TP} + \underline{M} = \underline{TC} + \underline{X}; \qquad (10)$$
$$\underline{TP} + \underline{M} = \underline{FD} + \underline{W} + \underline{X}; \qquad (11)$$
$$\underline{TP} + [Q]\underline{TP} = \underline{FD} + \underline{W} + \underline{X}; \qquad (12)$$
$$\underline{TP} + [Q]\underline{TP} = \underline{FD} + [A]\underline{TP} + \underline{X}; \qquad (13)$$
$$\underline{TP} + [Q]\underline{TP} - [A]\underline{TP} = \underline{FD} + \underline{X}; \qquad (14)$$
$$([I] + [Q] - [A])\underline{TP} = \underline{FD} + \underline{X}; \qquad (15)$$
$$\underline{TP} = ([I] + [Q] - [A])^{-1}(\underline{FD} + \underline{X}). \qquad (16)$$

Finally, the vector of generated incomes, $\underline{Y}$, may be calculated. An element $\{y_i\}$ represents the income generated in the ith industry:

$$\underline{Y} = \underline{V}'\,[I]\,\underline{TP}. \qquad (17)$$

Additionally, total State income, y^*, may be calculated

$$y^* = \underline{V}'\underline{TP}. \qquad (18)$$

[7]The notational conventions used throughout are: Vectors are underlined; matrices are indicated by brackets [ ]; elements of matrices are denoted by small, subscripted letters; scalars are indicated by small, asterisked letters; and the identity matrix is represented as $[I]$.

To close the model of the Maine economy, consumption demand must be removed from the final demand vector and made to depend endogenously upon the income generated within the model. To accomplish this, a 38th industry, the "household sector," is added to the transactions table, to the production vector, and to the consumption vector. The new column added to the transactions table measures the purchases of the household sector from each other sector. The new element in the total production vector equals total income. The new row in the transactions matrix represents the payments of all sectors to the household sector for services rendered in the process of production. This includes both labor and capital earnings. Because income is measured as value added in this model, the payments to the household sector by the jth industry $\{tr_{38,j}\}$ may be computed as:

$$tr_{38,j} = v_j \cdot tp_j. \tag{19}$$

The new element in the total consumption vector equals zero, because households are assumed not to purchase directly from other households.

After the construction of the household sector and its inclusion as a new industry in the transactions matrix, the solution for the closed model is exactly analogous to the open (no household sector) model.

Because an input-output model is linear, it is not necessary to resolve the system for every conceivable change in production. Rather, the ratio of change in income to change in total production in any sector is a constant "multiplier" which may be applied to any hypothetical change in production. These multipliers are extremely useful policy tools, and are the most important product of this analysis.

To compute these multipliers, both versions of the model were solved for base year (1963) final demands. To estimate the separate impact of each sector, (e.g., groundfish harvesting) the total value of output of each sector was inflated by $100,000. The model was then solved again to find a new total output vector consistent with this $100,000 increase. The increase in each element in the new total output vector measured the increase in gross output from each industry necessary to support the hypothesized $100,000 increase in output. The sum of these changes constitutes an estimate of the total impact (per $100,000) of groundfish harvesting (for example) on the gross output of industries within the State. This was done for each of the nine fishery sectors using both the "closed" and "open" models.

When combined with the information on value added in each industry, these estimates of change in the gross value of output can be translated into estimates of expected changes in income—direct, indirect, and induced. Direct income per dollar for any industry is simply v_i, the value added per dollar of output. The indirect plus direct income impact per dollar is computed as the ratio of the change in total State income to the change in gross output, as estimated in the open model. Subtraction of the direct effect yields the indirect effect alone. Finally, the change in direct plus indirect plus induced income per dollar of sales is estimated within the closed model. Again, the induced effect can be calculated by subtraction.

To summarize mathematically, let us introduce the notational convention that a subscript "o" refers to the open model and the subscript "c" refers to the closed model. The multipliers for each of the nine fisheries sectors are calculated:

$$\text{direct income multiplier} = v_i \tag{20}$$

$$\text{indirect income multiplier} = (\Delta y^*/\Delta tp_i)_o - v_i \tag{21}$$

$$\text{induced income multiplier} = (\Delta y^*/\Delta tp_i)_c - (\Delta y^*/\Delta tp_i)_o - v_i. \tag{22}$$

A Recommended Procedure for Assuring the Quality of Fish Fillets at Point of Consumption

LOUIS J. RONSIVALLI

Introduction

Although this discussion is limited to fish fillets, it might well apply to most seafoods in some cases and to all seafoods in other cases. Fish fillets, like meats and poultry, are perishable commodities that lose their eating quality relatively quickly. The rate at which fish fillets spoil depends on the temperature of the environment to which they are exposed (Charm et al., 1972; James and Olley, 1971; Spencer and Baines, 1964).

Fresh-caught fish that are iced immediately and held in ice thereafter will remain of high quality (U.S. Grade A) for 8-9 days and of edible quality for about 2 weeks. Held at room temperature on a hot day, the freshest fish will become inedible within 1 day.

At the other extreme, if fish are properly packaged, brought to a temperature of $-20°F$ (28.9°C), and held at that temperature or below, they will retain their high quality for more than 1 year and will remain edible for much longer. Thus, 100 percent of the eating quality of fish will be used up in only 1 day, 2 weeks, or more than 1 year, depending on the product temperature.

Currently, in the United States, fish are not held at a constant temperature throughout their distribution. Instead, they may be held at one temperature on the vessel, at another temperature in the processing plant, and at yet another temperature in the retail outlet. So, as fish proceed through the distribution chain, they are constantly losing quality, quickly or slowly, depending on their temperature. And, once the good quality is completely lost, the fish will soon become objectionable and, for all practical purposes, inedible.

The quality of fish is officially defined by the grade standards set by the U.S. Department of Commerce Inspection Service. The official standards for grades of quality of fish fillets are divided into three categories (Table 1): U.S. Grades A, B, and C. There is also a Substandard Grade that may be wholesome and of acceptable quality but does not meet physical specifications.

While we know that the quality of fish passes through Grades A, B, C and eventually to spoilage within 2 weeks at 32°F, and that fish fillets remain at U.S. Grade A level for 8-9 days, we do not know when fish go from Grade B to Grade C or when they fall below the Grade C level. However, the known facts suggest that these unknown times would be relatively short. For this reason and as an added insurance to assure quality at point of consumption, we are recommending that the intent is to have seafoods reach consumers while the seafoods are still of U.S. Grade A quality.

This paper outlines the handling procedures that will deliver U.S. Grade A fish fillets to the consumer and will generate a general attitude that recognizes the value of U.S. Grade A quality, the dietary and economic values of seafoods, and the economic value of eliminating spoilage and waste. Attainment of this goal should lead to:

1) That part of the U.S. seafood industry dealing in the commerce of fish fillets will earn a new image of prestige both at home and abroad.

2) That part of the U.S. seafood industry dealing in the commerce of fish fillets

Table 1.—Descriptions of U.S. Grade Standards for fish fillets (U.S. Department of Commerce, 1979). Greater detail on grading criteria is given in Official Grade Standard paragraph 203.104 (U.S. Department of Commerce, 1979).

Grade	Description
A	Good flavor and odor characteristics of the species; must comply with the limits for defects for U.S. Grade A.
B	Reasonably good flavor and odor characteristics of the species; must comply with the limits for defects for U.S. Grade B.
C	Minimal acceptable flavor and odor characteristics of the species with no objectionable off-flavors or off-odors; must comply with the limits for defects for U.S. Grade C.
Substandard	Minimal acceptable flavor and odor characteristics of the species with no objectionable off-flavors or off-odors; fails to meet the limits for physical defects for U.S. Grade C.

Louis J. Ronsivalli is Director, Gloucester Laboratory, Northeast Fisheries Center, National Marine Fisheries Service, NOAA, Emerson Avenue, Gloucester, MA 01930.

will become a more significant element in the U.S. economy, which should improve the U.S. position in international trade.

3) U.S. consumers will probably eat more fish, and this should tend to improve the overall health, especially in that proportion of the population who have an increased susceptibility to cardiovascular disease.

4) U.S. and foreign consumers of U.S.-produced fillets will get more for their purchase price which should increase the demand for U.S. fish fillets.

5) The introduction of some underutilized marine species to the U.S. seafood market may be facilitated.

Based partly on the rationale in the above discussion and partly on our experience in a study by Gorga et al. (1979), the strategy described below is recommended as a vehicle for obtaining the benefits listed above.

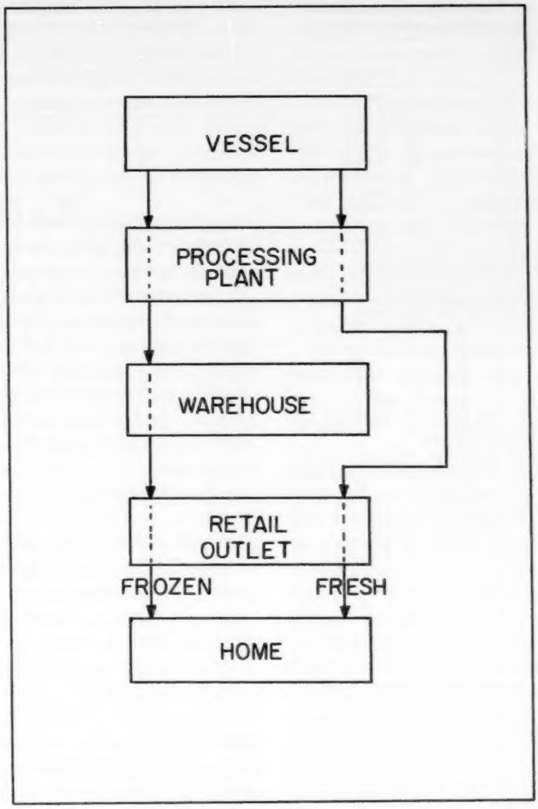


Figure 1.—The sequence of distribution elements that take fish from the sea to the table.

Rationale for the Recommended Procedure

It should, first of all, be noted that the spoilage patterns in unfrozen fish differ from those in frozen fish. In unfrozen fish, spoilage is due to the digestion of small protein particles (amino acids) by bacteria, and this type of spoilage results in the development of strong, objectionable odors and flavors. In frozen fish, spoilage is usually due to the action of certain enzymes on the protein and/or oxygen on the fats, and these types of spoilage may result in rancidity which can be detected in the odor or flavor (but may or may not be objectionable, depending on intensity) or they may result in toughening of the texture. Later in this paper we will recommend that fish displayed as fresh may be frozen and displayed as frozen as a means of removing the economic risk that the product might spoil before it can be sold, and we want the industry to be aware of the difference in spoilage patterns between frozen fish and unfrozen fish.

Figure 1 shows the sequence and the basic elements of the distribution chain that takes fish from the sea to the point of consumption. Although the figure shows only five distribution elements, it must be remembered that dock workers and transportation personnel are also involved to degrees that vary with a variety of possible situations to unload, reload, and transport the product from element to element. The product to be sold as fresh should be held at 32°F (0°C) or less (but not so cold that it freezes; otherwise, it has to be sold as frozen). The only element where the temperature can be allowed to rise (and then only up to 40°F (4.5°C)) is at the processing plant. This is because colder temperatures might not be tolerated by the plant's employees. (This is a factor which should be considered when evaluating the option of automated processing, such as mechanical filleting, which could be done at 32°F).

The figure shows that the fresh product does not go to a warehouse. This is because the total shelf life of fresh fillets is so short that there is no time for warehouse storage. The elements of the distribution chain will be described in more detail below; at this time, we should focus on the maximum times that the product can be held at each of the distribution elements. Table 2 provides insight to the limits of shelf life and Table 3 summarizes the maximum temperatures at which either fresh or frozen

Table 2.—The shelf life of fillets of gadoid species at some selected temperatures (no special packaging or other variables).[1]

Temperature °F	Temperature °C	Shelf life
90	26.7	1 day
60	15.6	2.5 days
42	5.6	6 days
32	0	2 weeks
29	−1.7	3-4 weeks
10	−12.2	~2 months
0	−17.8	~1 year
−10	−23.3	~2 years
−20	−28.9	>2 years
−40	−40	indefinitely

[1]It should be noted that the periods during which the fresh products remain at the U.S. Grade A level are shorter by about 40 percent than the shelf life times shown.

Table 3.—Maximum times that fish or fish fillets can be held at each distribution element when temperature is maintained at 32°F (0°C) and 0°F (−17.8°C), except at the vessel and on their first day at the processing plant.

Temperature	Vessel	Processing plant	Warehouse	Retail outlet	Home
32°F (0°C)	2 days	1 day		5 days	1 day
0°F (−17.8°C)	7 days	1-2 days	6 months	3 months	3 months

products can be held at each of the elements of distribution.

The data in Table 2 cannot be relied upon to be accurate for every occasion since many variables, which include species and season, exert an influence on what occurs under actual conditions, but they are as reliable as any set of single values that can be assembled for this purpose. The important consideration is the time/temperature relationships that are expressed and the implication of the potential economic penalty for being lax about temperature control. From Table 2, we can see that the time during which fillets of gadoid species remain at U.S. Grade A at 32°F is 8-9 days (60 percent of the shelf life which is about 14 days). This means that limits have to be placed on the times that the fish can be held at each of the distribution elements.

Table 3 shows the recommended maximum times that fish or fish fillets can be held at each distribution element when the temperature of the product is controlled to hold at 32°F (0°C). These data lead us to conclude that fish which are more than 7 days out of the water have no place at all in a guaranteed Grade A quality program for either fresh or frozen products. Only the catch from boats which fish for up to 2 days and the top of the catch from boats that fish for longer periods should be considered for the fresh market. The times in Table 3 may, to some, appear impractical or unattainable; and in some situations, this may well be the case for one or more of the elements. However, because of the time limitation which is unalterable, for every time increase allowed in any distribution element, there must be an equal time decrease in the rest of the system. The only element in Table 3 from which time can be subtracted is the retail outlet, but this is the only one of all the elements which cannot fix the time that it requires to carry out its responsibility—to sell the product. And, it is the element that will suffer the economic loss if it cannot sell the product. The retail outlet has no direct control over the consumer's decision to buy, and it should be remembered that part of the 5 days allowed at the retail outlet may have to be spent in the holding room from where no sale can be made. In order to extend the overall allowable time of 9 days shown in Table 2, the product temperature must be lowered to below 32°F, to perhaps 29°F (−1.7°C), where feasible (e.g., in the retail outlet holding room and display case). At 29°F, the spoilage rate is considerably slower than at 32°F.

Table 3 also shows the maximum times that fish or fish fillets can be held at each distribution element when the temperature of the product is controlled to hold at 0°F (−17.8°C). There should be no problem with the holding times shown in the table when the fish are properly packaged. By lowering the product temperature, the times can be extended. The only element that may be controversial is the vessel. Despite the opinions of some who contend that fish can be held for 10 days or more in ice before putting them into the distribution chain, it is just not so. Fish older than 7 days in ice will probably not be at U.S. Grade A at point of consumption, except under unusual circumstances. This does not mean that vessels should not make trips that are longer than 7 days or that fish older than 7 days are of no value. It only means that fish older than 7 days in ice should not be scheduled for a distribution system which is expected to deliver to the consumer either fresh or frozen fish fillets of U.S. Grade A quality. In the following section, which includes a description of the vessel's role in more detail, recommendations are made for fish that are 8 days or more out of the water.

Elements of Distribution

Vessel

Theoretically, the optimum method of handling fish is to freeze them immediately after catching. By freezing the fish at sea and holding them at sufficiently low temperatures (no higher than 0°F or −17.8°C), they will remain at high quality for months. Freezing to and holding at even lower temperatures (e.g., −20°F or −28.9°C), will maintain high product quality for more than 1 year. However, since most of the vessels harvesting groundfish off the U.S. coasts do not freeze their catches, this section will deal only with handling fish at 32°F (0°C).

The species of concern may be caught by hook and line, otter trawl, trap, or gill net. Regardless of the method, the important thing is that the fish are brought to the temperature of melting ice as soon after death as possible. Thus, it can be seen that fish trapped in a gill net that is left in the water for a long period may undergo considerable quality degradation before they are brought on board the vessel. On the other hand, fish that are trapped or hooked may be alive and of prime quality when hauled on board. Fish that do not struggle retain their blood sugar, which is subsequently broken down to lactic acid which slows the rate of spoilage (Amlacher, 1961).

Fish caught by long line or traps have better keeping quality than fish caught by trawling. In the latter process, the fish are dragged along the ocean bottom and, in addition, they are subjected to considerable pressure when the net is hauled out of the water. This not only damages

the texture but also may force some of the intestinal contents out of the fish, thus contaminating the surfaces of surrounding fish. Sophisticated methods of handling fish, such as stunning them in an electrical field and then pumping the stunned fish on board, are already developed, although they are little used at present.

As stated, the most critical of all the deck handling operations is lowering the temperature of the fish as soon as possible after catching to retard spoilage. The temperature of the fish is usually lowered by icing the fish in the hold. However, if this is improperly done (i.e., if the fish are allowed to be pressed against the pen boards without an intervening layer of ice), the fish may develop a bilgy flavor and odor. Also if the fish are piled too high, excessive pressure on the bottom fish damages them. This can be prevented by stowing the fish iced in boxes or in refrigerated seawater. The latter offers the additional advantages of rapid heat removal and lowering of the temperature of the fish very close to its freezing temperature, resulting in an increase in storage life. Of course, there is no place in a guaranteed quality program for fish that are not adequately cooled, such as occurs when ice or other refrigerant is not used or when the amount of ice or other refrigerant is inadequate. The use of boxes and proper icing is highly recommended. Also, the boxes should carry the date when they are filled.

The fish should be eviscerated, since the stomach contents may contain feed with high proteolytic activity which can rapidly digest the belly area. Ideally, the viscera should be removed intact, as rupturing results in inoculating the abdominal cavity and accelerating spoilage, but this is admittedly not practical with present techniques. Vacuum evisceration (Connors and Baker, 1968) would be one way to remove the viscera with a minimum of contamination of the gut cavity with its contents, but there are no reports of the current use of this process.

The value of washing freshly caught fish is questionable. The growth of bacteria on round fish occurs principally on the external slime layer as well as in the gills. On fresh-caught fish, this slime layer is firmly bound and washing does little, if anything, to remove it (Castell et al., 1956). Bleeding the fish is a good practice since it results in a lighter colored flesh and it removes heme compounds which accelerate oxidative rancidity. Peters (1969) showed that a side benefit of vacuum evisceration was the simultaneous bleeding of fish.

For short-term storage, the use of refrigerated seawater and chilled seawater systems are among the best that can be used because of the rapidity with which they can cool fish and the thorough temperature control that is possible. Because of the buoyancy effect of such systems, fish are not pressure damaged and they are easier to unload, especially by pump. For more information on these systems, the reader is referred to Peters et al. (1965) and Hulme and Baker (1977).

Until recent years, the pitchfork was extensively used for transferring fish from the pen to unloading systems and sometimes within the processing plant to unload fish from boxes. This was a poor practice which bruised and contaminated fish muscle and is now virtually eliminated. Where it is still used, evidence is seen in the blood spots and discolorations of the muscle. What is not immediately evident is the extent of bacterial inoculation.

When fish are boxed and iced at sea, the boxes are hauled out by a mechanical hoist, and this is an ideal method of unloading. The power hoist and basket is a satisfactory system for unloading fish from pens, but transferring the fish from the pens to the basket is still a time-consuming and inefficient task.

Many fish are landed at dockside processing plants, and in those cases, the only cause for concern should be that the product be moved as quickly as possible. Even when, for some reason, the product must wait, its temperature should not be allowed to rise. This means that it must be sufficiently iced to keep it at 32°F (0°C).

Much of the landed fish is moved to plants that vary in distance from the dock, so a variety of transporting devices may be used. These range from manually pushed carts that travel short distances to trucks which may have to travel long distances. Regardless of the mode and distance of travel, the emphasis must be on temperature control and rapid handling.

Having covered the specifications and limits recommended at the vessel, it is now time to discuss the fate of fish that are more than 7 days old when landed. First, it should be reasserted that there just is not enough high quality remaining in iced fish that are 8 days or more out of the water to last them through the distribution system and to be of U.S. Grade A quality at time of consumption.

As this entire recommended handling procedure depends entirely on the premise that all activities will be aimed to achieve and maintain a respectable image for the seafood industry, there can be no compromise of the established protocol. This means that vessels which have no facilities to maintain the temperature of the catch at less than 32°F (0°C) should not stay out longer than 7 days at sea, or they should plan another way to handle that catch portion that will be more than 7 days old when landed.

There may be a specific buyer who has the facilities to handle the fish quickly, e.g., a shoreside restaurant that has a high demand and quick turnover for seafood entrees and whose employees are expert in seafood quality and are reliable enough to cull out an inferior product. Or, a shoreside processing plant may be found which has the facility to quick-freeze the high quality part of the catch and has personnel with the expertise to assess accurately the quality of fish and the reliability to cull out fish that will compromise the image that we are trying to make for the U.S. seafood industry.

Another alternative for vessels that plan to fish for more than 7 days is to handle the first part of the catch to preserve its quality. Here, there are two practical possibilities. One way is to freeze the first part of the catch. This can be done by installing a small freezer on board the vessel. The second possibility is to salt the first part of the catch at sea. Either alternative is more economical and more practical than putting the first part of the catch into the normal fillet distribution chain as is done now.

Another alternative is to consider a technique that has been proposed in the past for the U.S. fleet, and is already practiced by the Japanese and possibly others: Use fast transport vessels that take fish from fishing vessels before the fish become too "old" to safely put into the distribution system.

Fishermen must constantly remember that it is not enough to bring in fish that is of high quality when landed, because that is not where the quality judgment is made by the consumer. Landed fish must have a reserve of high quality to last it to the point of consumption.

Processor

Processing room temperatures should be no higher than 40°F (4.5°C). The product should be handled quickly, and there should be no delays in the plant. The plant should be under U.S. Department of Commerce inspection to insure that good manufacturing practices are observed. The refrigerated holding room should be at 29°F (−1.7°C) but not higher than 32°F (0°C), and the freezer holding room temperature should be as low as possible and feasible but not higher than 0°F (−17.8°C).

The product should be prepackaged at the processing plant. This would insure that the product could not subsequently be exposed to pathogenic microorganisms (as can readily occur when handled under uncontrolled conditions). Individual packaging would also permit the application of the U.S. Department of Commerce inspection seal, the U.S. Grade A label, the company identification mark, a logo, a code to tell by which time the product should be used, weight, and other relevant information. The package should be transparent to help consumers evaluate the product at time of purchase. At the processor level, U.S. Grade A fresh fillets could be transferred to the freezer just before their quality fell to below U.S. Grade A. In this way, none of the fillets would be lost to spoilage. It should be emphasized that only fillets that are still of U.S. Grade A should be frozen. Once they fall to below U.S. Grade A, they should be discarded.

Relevant to the merchandising of U.S. Grade A fillets is the current concept that fresh ones are of higher quality and command a better price than frozen ones. Because of this concept, anyone who processes or otherwise handles fillets anywhere in the distribution is compelled, for economic reasons, to sell his inventory as fresh if he can. Also, because of this, fillets produced in the United States are only handled as frozen when their quality is such that they could not be sold in the fresh market. Thus, the concept that fresh is better than frozen is propagated. There is a need to demonstrate the higher value of frozen fillets over fresh fillets, because ultimately the best quality fillets and the best overall economic benefits will come from freezing the highest quality fish and fish fillets.

Processors must constantly remember that it is not enough to produce seafood products that are of high quality, because that is not where the quality judgment is made by the consumer. Products must have a reserve of high quality to last to the point of consumption.

Warehouse

There is little likelihood that any product quality will be lost at the freezer warehouse as long as temperature control and product rotation are maintained and there are no delays in loading and unloading at the warehouse dock. The product temperature should never exceed 0°F (−17.8°C), but it should be obvious that lower temperatures provide a better protection of product quality. Temperature fluctuation should be minimized.

There is no provision for storing fresh fillets in warehouses because of the limited time that they have as U.S. Grade A product. However, for distribution in supermarket chains, they may be sent to the chain's perishables distribution center. This is not for storage, but to facilitate distribution. The product must be moved in quickly as soon as the supply trucks arrive and out just as quickly to the delivery trucks that distribute the product to the retail outlets. Trips to the retail outlets must be short so that deliveries are made within just a few hours. Trucks should maintain a temperature of about 29°F (−1.7°C) but not higher than 32°F (0°C). Supplies can arrive by truck only as long as deliveries from the processing plant can be made within 1 day. Deliveries requiring more than 1 day by truck should be made by airfreight. The temperature during delivery should be maintained at 29°F (−1.7°C), but not higher than 32°F (0°C).

Retail Outlet

Product handling at the retail outlet is shown in Figure 2 in isolation from the rest of the distribution chain, to show the details of the recommended pattern for handling fish fillets. Fillets received at the retailer's unloading platform should be transferred immediately to the holding rooms. This step should not wait because of a lunch break, coffee break, or any other reason.

Holding room temperatures should be strictly controlled. The freezer room should maintain as low a temperature as possible, but under no circumstances should it be higher than 0°F (−17.8°C). The refrigeration room should maintain a temperature of about 29°F (−1.7°C), but under no circumstances should it be higher than 32°F (0°C).

Since fresh fillets have only a limited time that they can be held at the retail outlet (about 5 days under favorable circumstances), it can be seen that every day that they spend in the holding room means 1 less day on display, and those not displayed cannot be sold.

Seafoods generally provide a retailer with a relatively high return. Therefore, the retailer should devote adequate time to see that the display cases are held at the proper temperature; that the display cases are not overloaded (so proper product temperature can be maintained); that the fillets are rotated; and, especially, that fillets which are lower than U.S. Grade A quality are removed and discarded and not frozen for subsequent display in a freezer case or sold at a lower price. Either of these latter practices simply propagates the relatively low image of seafood quality and provides no economic advantage for the long term unless they are properly done as described in the following two paragraphs.

Transfer of fresh seafoods to a freezer or to the freezer display case should be done no later than 1 day before the pull date. Assuming that the packaging material is suitable, only the pull date and

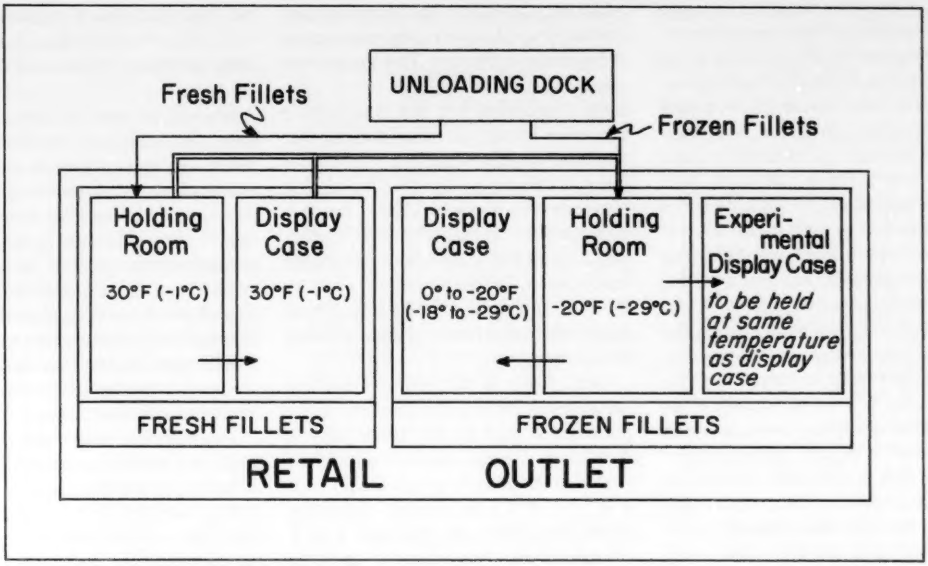


Figure 2.—Recommend handling of fish fillets at the retail outlet to maximize quality retention and minimize losses due to spoilage.

any reference to freshness need be changed. Even if the freezing process is slow, by starting it 1 day early, spoilage reactions will be slowed and finally come to a virtual halt soon enough so that the product will retain its U.S. Grade A quality. In Figure 2, the double lines refer to fresh fish that are transferred to the freezer section 1 day before the pull date. Times to allow for pull dates on frozen products can be obtained from Table 1.

It should be perfectly all right to sell at discount those seafoods that do not have much U.S. Grade A quality left. However, the retailer must be sure to discard the product once its quality falls to below U.S. Grade A.

It is important that the retailer remove seafoods of less than U.S. Grade A from display because of the current poor image of seafoods. Quality assurance of seafoods can increase the consumer demand for them, but because of the poor image of these products, the industry has to exercise even greater care than is now exercised for meats and poultry, both of which have an image of good quality among consumers.

The experimental display case cited in Figure 2 refers to a new concept in frozen fish merchandising which was designed to minimize heat gain from the outside of the box (i.e., to minimize loss of refrigerated air to the outside) and to make rotation of the product fail-proof. This is accomplished by loading the product onto a one-way track in a completely enclosed case much like a vending machine used for the automated sales of candy bars and cigarettes. A description of the case and of the details of seafood display are described in greater detail by Nickerson and Ronsivalli (1979).

As we are concerned only with packaged fillets, the package makes it convenient to put a date on it, such as a pull date. This is already being done in some cases. The reason for the pull date (the date by which time the product will have reached near the end of its U.S. Grade A quality) is to let a consumer know how soon the product must be used to insure that it is Grade A at time of use, and it lets the market personnel know when it must be removed from the display case if unsold.

Having covered the justification for the pull date (sometimes a use-by date is used which is self-explanatory), its disadvantage and possible alternative strategies should be considered. Its disadvantage is that customers are bound to look for the newer product making it difficult to sell the older product and perhaps even losing it to spoilage. A better alternative to the use of a pull date is to use a code for the pull date. The customer would not be misled because, regardless of the pull date, every package on display would contain U.S. Grade A product, and the market manager would still be able to tell when a package should be removed from the case and which products should be sold first.

In addition to the responsibilities of the retail outlet personnel described above, there are other measures that they can take since they make up the single element in the distribution chain that interacts directly with the consumer. They are in a good position to impart information regarding methods of preparation, dietary facts, facts on preservation of quality, etc., to the consumer. One way to help protect perishable commodities like seafoods is by designing

the market layout to minimize exposure of the product to high temperatures. Recognizing that the layout design serves many purposes, it should also be recognized that in most supermarkets, a most important consideration has been overlooked. Currently, perishables can be found at any point in the store, and, except for occasional arrows in the aisles (which very few people observe), one can enter a supermarket, start shopping at any end of the store and end up at the opposite end. Thus, regardless of the pattern used when a general grocery list is sought, there is a high probability that one of the first items to be put into the shopping cart will be perishable. This helter-skelter shopping pattern is not helpful. Market layouts should be designed so that a customer should be confined to a one-way passage through the store, and the store should be in sections such that the first section encountered contains the least perishable commodities, the final section contains the most perishable commodities, and all other sections to be in a sequence consistent with the obvious pattern.

The retailer is the key to the image of the seafood industry. He gets customer feedback, and he can apply pressure to suppliers. He can educate the consumers and the suppliers as well.

Retailers must remember that when they receive seafood products of high quality, that alone does not insure that the product will be of high quality when the consumer eventually eats it, and that is where and when the quality of the product is eventually judged.

Consumer

Fillets may be purchased fresh or frozen. In either case, once the purchase has been made, the consumer should make every effort to keep them at the desired temperature until consumed (32°F (0°C) if fresh and 0°F (−17.8°C or lower) if frozen). The cart or carriage used to contain supermarket purchases is not refrigerated and the car or other means of conveyance to bring the food to the home is not refrigerated. Therefore, from the moment that fish and other perishables (e.g., meats, eggs, and milk) are placed into the shopping cart, no time should be lost to get them into a refrigerator or freezer. This means that shopping for food requires a little planning. A shopping trip that is to include groceries should be scheduled so that the food market is the last stop before going home, especially when the outside temperature is high. Also, the trip through the food market should be planned so that the selection of perishable foods is left for the end of the trip. By this type of planning, the good quality of fillets will have a better chance of being maintained.

Once fish is in the home, it must be refrigerated immediately and before any attention is paid to the nonperishable purchases. Frozen seafoods should be placed in the freezer (which should be at 0°F (−17.8°C) or lower). Attention should be paid to the package. It may offer sufficient protection so that the seafood could be stored in its original package. The ideal package prevents the loss of water. The package should prevent the entry of air when it contains fatty fish. Even frozen seafoods eventually undergo quality deterioration, albeit very slowly (Table 1).

Unless fresh fillets are to be prepared within minutes, they should be put into the refrigerator immediately; and, if they are to be held in the refrigerator for more than a few hours, they should be imbedded in ice in a leak-proof container such as a large bowl. This is because most refrigerators are held at temperatures that are too high for fish fillet storage. Only fish that are to be consumed within 24 hours should be stored unfrozen unless it is known for certain that the fish have been caught recently.

The point at which the quality of a fish fillet really counts is when it is being consumed. At any other point, quality is important only as an indicator of what can be expected when the fillet is consumed.

That fact that fish coming out of a vessel's hold look and smell good indicates (but does not assure) that it will be good to eat. The fact that an inspector judges a fillet to be U.S. Grade A quality at the processing plant indicates (but does not assure) that it will be good to eat. The fact that a consumer buys a U.S. Grade A quality fillet indicates (but does not assure) that it will be good to eat.

Only at the point of eating does one sense the quality of the fillet. When a fish is of high quality at the time of preparation, but does not give the impression of high quality when it is consumed, the implication is that it was not properly prepared. This discussion will not address the preparation of seafood since that information is available elsewhere. But, it appears that seafoods do require special attention during preparation, and this step should not be underestimated in importance.

There is very little excuse for U.S.-produced seafood products to be anything but good eating quality, and consumers can help to bring this about by returning to the vendor any seafood that has off-odors (i.e., ammonia, sulfide, or the odor often described as "fishy"), off-flavors (i.e., rancid), or poor texture (i.e., tough and/or dehydrated).

The Need for Monitoring

Of all the fresh and frozen flesh foods available to the U.S. consumer, only seafoods are not produced under mandatory inspection; and of all fresh and frozen flesh foods available to the U.S. consumer, only fish have a high degree of unreliable and inconsistent quality (Anonymous, 1973). It is the human tendency to wander from committed and/or expected performance unless there is some sort of mechanism to monitor performance.

The handling procedure recommended in this paper has considerable potential, but it is unlikely that the full potential will be realized or that whatever level of success is reached can be sustained unless a provision for monitoring the procedure is included. Nothing is more disappointing to all concerned than a commitment which is not met consistently. The image of the U.S. Department of Commerce Inspection Service, the image of the company that produces U.S. Grade A fillets, and the image of the logo which identifies the U.S. Grade A product will all suffer unless consumers

find the products to be consistently of U.S. Grade A quality.

Therefore, it is strongly recommended that a private monitoring organization be established. Such an organization may receive its income from a fee to be paid by the processor on a per pound basis, the cost of which can be passed on through the retailer to the consumer. The monitoring organization would use its income to catalog all processors, retailers, etc. that handle the product identified by a logo or mark and to spot check the performance of its members for compliance. It would spot check retail outlets and vessels, and it would assume the responsibility of assuring the product quality level at point of sale.

Note: This recommended procedure is not to be construed as a policy of the National Marine Fisheries Service.

Literature Cited

Amlacher, E. 1961. Rigor mortis in fish. *In* G. Borgstrom (editor), Fish as Food, Vol. 1, p. 385-409. Acad. Press, N.Y.

Anonymous. 1973. Frozen fish fillets. Consumer Rep. 38(12):92-95.

Castell, C. H., W. A. MacCallum, and H. E. Power. 1956. Spoilage of fish in the vessels at sea: 2. Treatment on the deck and in the hold. J. Fish. Res. Board Can. 13:21-39.

Charm, S. E., R. J. Learson, L. J. Ronsivalli, and M. S. Schwartz. 1972. Organoleptic technique predicts refrigeration shelf life of fish. Food Technol. 26(7):65-68.

Connors, T. J., and D. W. Baker. 1968. Vacuum evisceration: A modern method of cleaning fish at sea. Mar. Fish. Rev. 30(7):39-41.

Gorga, C., J. D. Kaylor, J. H. Carver, J. M. Mendelsohn, and L. J. Ronsivalli. 1979. The economic feasibility of assuring U.S. Grade A quality of fresh seafoods to the consumer. Mar. Fish. Rev. 41(7):20-27.

Hulme, S. E., and D. W. Baker. 1977. Chilled seawater system for bulkholding sea herring. Mar. Fish. Rev. 39(3):4-9.

James, D. G., and J. Olley. 1971. Spoilage of shark. Aust. Fish. 30(4):11-13.

Nickerson, J. T. R., and L. J. Ronsivalli. 1979. High quality frozen seafoods: The need and the potential in the United States. Mar. Fish. Rev. 41(4):1-7.

Peters, J. A. 1969. Vacuum evisceration. Report on some bacteriological and sensory tests. Supplement to Cruise Report *M/V Delaware*, Cruise 69-4, April 8-13, National Marine Fisheries Service, Emerson Avenue, Gloucester, MA 01930.

_________, C. J. Carlson, and D. W. Baker. 1965. Refrigerated sea water as a storage medium for fish. ASHRAE 7(4):64-67.

Spencer, R., and C. R. Baines. 1964. The effect of temperature on the spoilage of wet white fish. I. Storage at constant temperatures between $-1°$ and 25°C. Food Technol. 18(5): 175-179.

U.S. Department of Commerce. 1979. U.S. general standards for fish fillets. Fed. Regist. 44(110):32385-32388.

The Clam-Kicking Fishery of North Carolina

JAMES F. GUTHRIE and CURTIS W. LEWIS

James F. Guthrie and Curtis W. Lewis are with the Beaufort Laboratory, Southeast Fisheries Center, National Marine Fisheries Service, NOAA, Beaufort, NC 28516. This paper is Contribution No. 81-43B from the SGFC's Beaufort Laboratory.

ABSTRACT— The historical progression of methods and gear in the clam-kicking fishery of North Carolina is described, from the original anchor method to the present fishery in which southern quahog clams, Mercenaria mercenaria *(Linne), are mechanically blown from the bottom by wash from a boat propeller and are retained in a special 12-20 foot wide trawl towed behind a 17-45 foot boat. We trace the history of the fishery and describe the several techniques in sufficient detail to enable the reader to adapt any of them for fishing in other shallow water areas. Focus is on Carteret County, N.C., where the fishery and gear innovations are believed to have originated in about 1940 and which is still the leading clam producing county.*

Introduction

At about the time that fishermen in North Carolina were beginning to convert from sail to small engine power, long-haul fishermen (Guthrie et al., 1973) noticed quahog clams, *Mercenaria mercenaria*, lying exposed in shallow waters where boats pulling the long nets had passed over them. They deduced that the prop wash from their boats was dislodging, or kicking, the clams out of the mud and throwing them on the surface. The fishermen soon realized that the prop wash might be utilized to harvest clams commercially far more efficiently than methods then in use. Clamming at that time was primarily done by hand raking, signing (sighting the excreting hole of an individual clam), or trodding in shallow water on an intertidal shoal (feeling clams in soft bottom with your feet).

The method of harvesting clams by kicking, or using the propeller backwash to extract clams from the substrate, has gone through several stages of development since it was first tried in the early 1940's. In this paper we trace the history of this development and describe the four different techniques that have been used.

Since 1950 the North Carolina clam catch by all methods has varied from a low of 122,000 pounds of meats in 1955 (dockside value $35,000) to a high of 1,541,719 pounds (dockside value $5,554,047) in 1980 (Table 1). Harvesting by kicking is regulated by the North Carolina Division of Marine Fisheries, which sets by proclamation the opening and closing of the season, the months the season will be open, and places where boats are allowed to operate. According to law enforcement personnel, 147 boats were active in Carteret County in 1980. Since kicking does not require an elaborate array of equipment, fishermen consider it a welcome addition to their seasonal fishery repertoire.

Table 1.—Annual catch and value of hard clams landed in Carteret County, N.C., and in all North Carolina counties.

	Carteret County		All counties	
Year	Pounds (10^3)	Value ($\$10^3$)	Pounds (10^3)	Value ($\$10^3$)
1950	803	150	836	157
1951	760	175	834	192
1952	684	157	724	166
1953	421	109	445	116
1954	206	60	244	72
1955	65	20	122	35
1956	121	42	148	52
1957	217	87	243	98
1958	210	84	278	111
1959	235	94	340	136
1960	334	137	432	173
1961	248	99	490	196
1962	98	39	247	99
1963	168	66	332	130
1964	90	34	225	98
1965	63	28	313	137
1966	70	28	285	110
1967	27	12	287	133
1968	19	10	251	132
1969	31	17	292	154
1970	65	36	336	173
1971	82	46	300	162
1972	77	42	274	163
1973	137	112	379	294
1974	67	70	288	322
1975	77	58	285	226
1976	93	77	306	258
1977	543	816	739	1,069
1978	583	1,543	892	2,449
1979	777	2,272	1,450	4,474
1980	876	3,014	1,542	5,554

Anchor Method

The anchor method is believed to have originated at Harkers Island, N.C., in Carteret County (Fig. 1) about 40 years ago. At first, kicking was done by placing an anchor 25-75 yards (18-25 m) behind the boat, which stopped forward progress but allowed the boat to swing in an arc (Fig. 2). Usually a source of weight was shifted to the stern of the boat to increase the amount of propeller wash directed toward the bottom. Once anchored, the boat was headed into the tide and moved in a half-moon arc, the circumference of the kick being determined by the length of the anchor cable. After the tide swept the turbid water from the kicked areas, the fisherman picked up the exposed clams with a rake. This process was repeated after more cable had been let out to allow the boat to move forward to an unkicked area. Before starting a day's activity a fisherman would try several areas and select the one where clams were most plentiful. The basic method, with its modifications, became popular since it could be done by one fisherman in virtually any small boat, and soon spread through coastal communities. The first person to devise or employ the technique remains unknown, but it soon led to a modification termed the "bedstead."

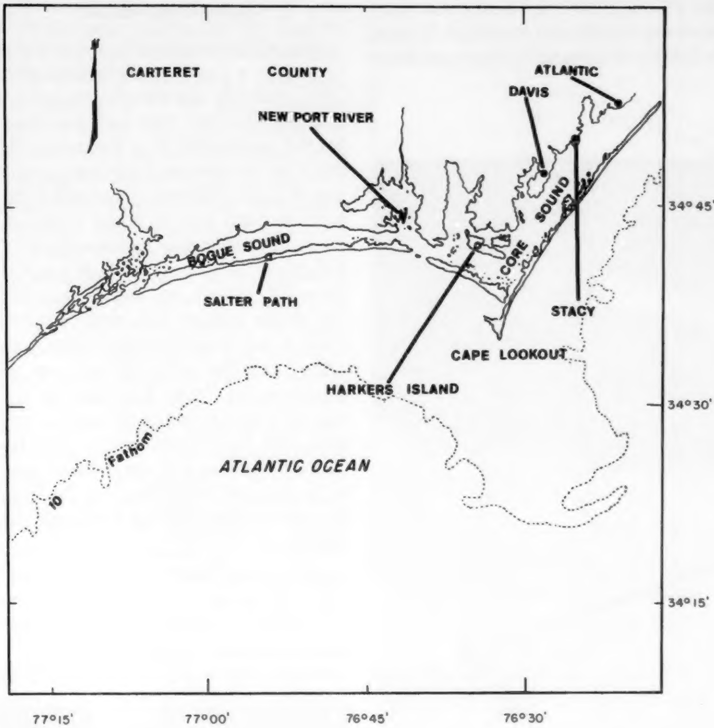


Figure 1.—Areas in coastal North Carolina where harvesting clams by kicking them from the mud with propeller backwash originated.

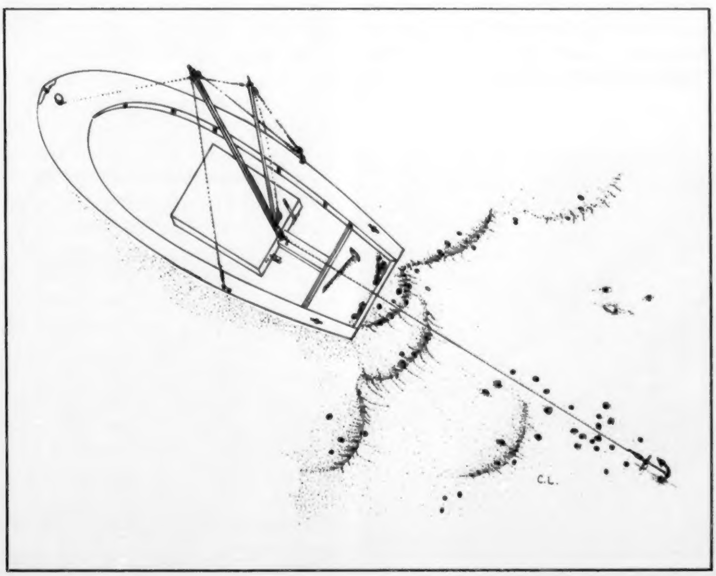


Figure 2.—Diagram of the anchor method for kicking clams.

Bedstead Method

This method is believed to have been developed at Stacy, N.C., during the early to middle 1940's and employed a modification of a gear formerly used to harvest blue crabs, *Callinectes sapidus* (Rathbun). The bedstead, 7 feet wide by 3 feet 4.5 inches high and set on sleds (Fig. 3), weighed, by conservative estimates, at least 150 pounds. The boat pulled the gear behind it in an arc as it swung on the anchor. Clams kicked out by the prop wash were scooped up and collected in the bunt, which was made of heavy twine and had a loose but heavy lead line attached. To retrieve the kicked clams from the bunt, the bedstead was lifted onto the stern, the lead line was brought aboard, and the contents were dumped on the stern, or cockpit, of the boat. This gear was heavy and awkward, but it allowed the fishermen to remain aboard the boat at all times. They were not as dependent upon fair weather or on tide to remove turbid water as they were when using the anchor method, and they could harvest clams in deeper water. Usually at least three people working from the same boat were required (Fig. 4).

A small skiff was often carried and secured on the leeward side of the kicking boat. Empty shells and debris culled from the catch were shoveled into the skiff and later dumped inside the kicking arc near the anchor, or in an area not being kicked. If the bunt had a large catch of clams or an excess amount of debris, the catch was dumped directly into the small skiff, because less effort

was required to lift the heavy gear into the low-riding skiff than to lift it into the kicking boat. The bedstead was effective but it proved to be too heavy and cumbersome. It was used for only 1-2 years before it was replaced by the oyster drag.

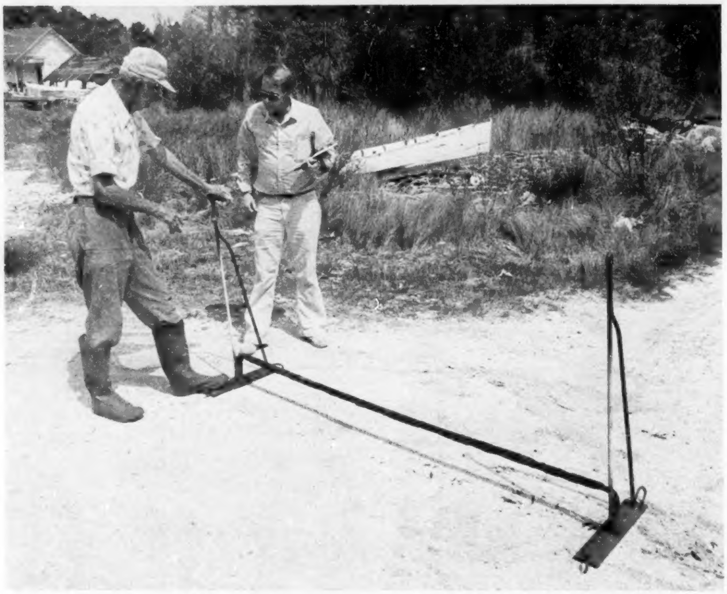


Figure 3.—The basic bedstead frame, to which a trawl net was attached.

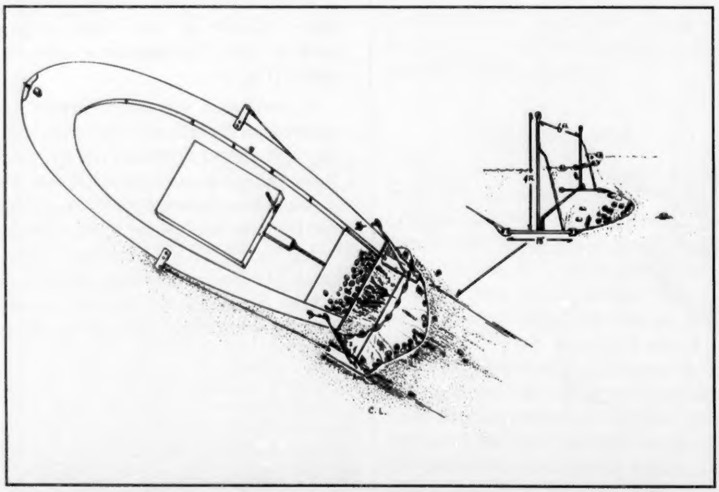


Figure 4.—Diagram of a boat rigged for harvesting clams by the bedstead method.

Oyster Drag Method

A modified oyster dredge, converted for use as a clam drag sometime after 1945, probably represented the first automated clam harvester used in coastal North Carolina (Fig. 5). It was reportedly first tried by someone from the community of Davis. The drag was about 4 feet wide and was used to scoop clams off the bottom after they had already been kicked out by the prop wash. It weighed about 100 pounds and had a removable bar on the bottom with teeth 3 inches long. A bag made of metal rings connected together with S-hooks was attached to the frame. The rings on the top were larger than those on the bottom. The heavy clams were thus retained in the bag and worked their way to the cod end, while much of the floating debris passed through the larger top rings.

Figure 5.—The oyster drag with bunt attached.

A kicking stake (inset, Fig. 6) was used with this gear, permitting the boat to kick in a complete circle without tripping an anchor. The stake was a 3 inch diameter pipe about 12 feet long. A sleeve about 6 inches long and 3.5 inches in diameter with an eye bolt welded to it was slipped over the stake, resting on a stop placed about 4 feet off the bottom. The stake with the sleeve in place, and a rope sling at the top to help in pulling it up when fishing was done, was driven 4 feet into the bottom with a heavy maul. A cable from the eyebolt on the sleeve passed through a brass ring or single block on the front pull post of the boat and then through another block on a second post mounted on the port side about two-thirds of the way towards the stern. Cable was payed out in 6-8 inch increments each time the boat moved around the stake, allowing the boat to move in an ever-widening circle and cover a new area. Sometimes the stake was moved 10 or 12 times per day, depending on availability of clams.

The drag was transported, carried, and fished on the port side of the boat just a little aft of the stern. A towing cable was secured to a high post located on the starboard side. It ran across the boat, around a turn post located aft of the culling tray on the port side, through a single block on the tip end of the drag, back to another single block on the high post, and then through a single block located aft of the engine housing that lined up the cable on the drum spool (Fig. 6). The turn post, 2 or 3 feet high, also was used to turn the drag toward the rollers, which were mounted at the edge of the deck in front of the culling tray. The drag was pulled to the boat so that its teeth barely touched the side of the boat, and the catch was rolled onto the culling tray. Usually two or more men fished together.

The boat was slowed by two trawl boards used like sea anchors directly aft of the boat. These boards were 6 feet × 2.5 feet, with the inside ends tied together at the top and bottom by ropes 2 or 3 feet long (Fig. 6). The boards were secured to the stern pull post by either a single bridled line or by a line from each board. In bad weather a single trawl board was used off the starboard side to keep the boat from getting too close or too far away from the kicking stake. This board was secured at the front pull post and held at a set distance off the starboard side by a line running from the board to a mid pull post. The oyster drag was an extremely efficient gear, and on some days 10,000 pounds of clams were harvested by a single boat. It was used until the development of the clam trawl.

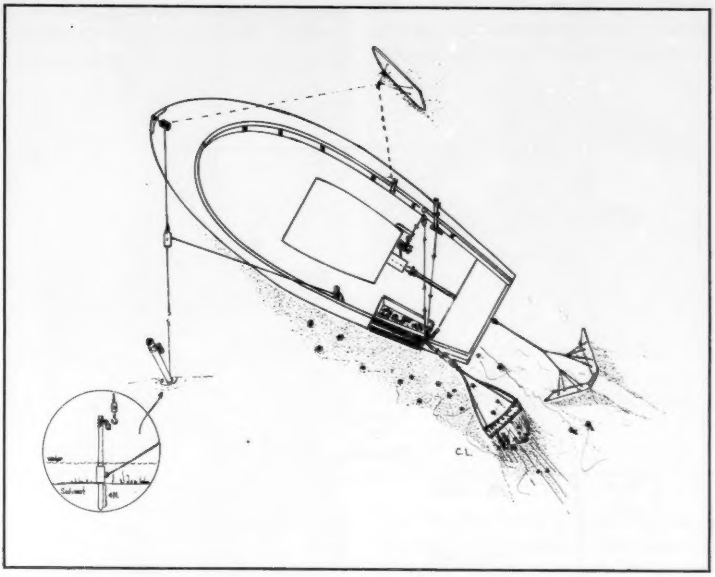


Figure 6.—Diagram of a boat rigged for harvesting clams by the oyster drag method.

Clam Trawl

The first clam trawl reportedly was tried at Atlantic, N.C., in 1968. It has not been changed appreciably, except for some minor modifications to allow escapement of debris over the top of the net. The major advantages of this gear are simplicity and maneuverability (Fig. 7, 8). The trawl boards are attached

Figure 7.—The clam trawl, with boards attached.

directly to the net, the gear is fished about 15 feet behind the boat, and the boat is not attached to a stake or anchor. A single towing line that runs from the winch through a block on the lower mast is bridled to the trawl boards (Fig. 9). A lazy line around the cod end runs through a block high on the mast, enabling the whole net to be lifted out of the water for dumping the catch.

The typical clam trawl designed for a 21 foot boat is 10 to 12 feet long and is hung on 0.5 inch polydacron rope with 72-84 strand braided nylon twine. Twine size in the trawl body varies from 42-84 strand nylon (rolled or braided). Mesh size varies from 1.25 inch bar in the bottom to 3 inch bar in the body. The same twine and mesh size are used in the larger trawls. The net usually is pulled with one or two 2-5/16 inch tickler chains 12 inches ahead of three chains attached to the bottom of the net as a lead line. The three chains (0.5 inch dia.) are hooked together by a series of S-hooks attached directly to the net (Fig. 10). A 25-mesh square in the bottom and top of the cod end of the net is usually cut out and replaced by 1.25 inch diameter metal rings also held together by S-hooks.

The trawl board for the 10-12 foot trawl is 5 feet × 2 feet and is typically slung one-third (Fig. 11) (i.e., when the bridle links are pulled tight they form a diamond on the lower one-third of the board, though individual boards vary in setting). Trawl board and net size vary with the size of the kicking boat and depths of the water fished. Boards for a 20 foot clam trawl may be up to 9 feet × 3.5 feet. Kicking is generally restricted to depths less than 10 feet. Fishermen generally try to position the propeller about 12-15 inches above the bottom for most efficient operation. Boats with drafts up to 7 feet can clam in water up to 10 feet, while boats built with a tunnel for the propeller shaft can clam at depths of 1 to 2 feet. Weight can be added to the stern or shifted around on the boat to achieve the optimum propeller angle and depth above the bottom.

To help make a boat more efficient in varying water depths, a winged rudder was introduced by some fishermen in 1976 (Fig. 12). Essentially, it is simply a rudder to which two iron deflectors have been welded at an angle of about 30°. The deflectors extend about 18 inches on either side of the rudder and bend downward at an angle of about 20° 9 or 10 inches from the center post. Water

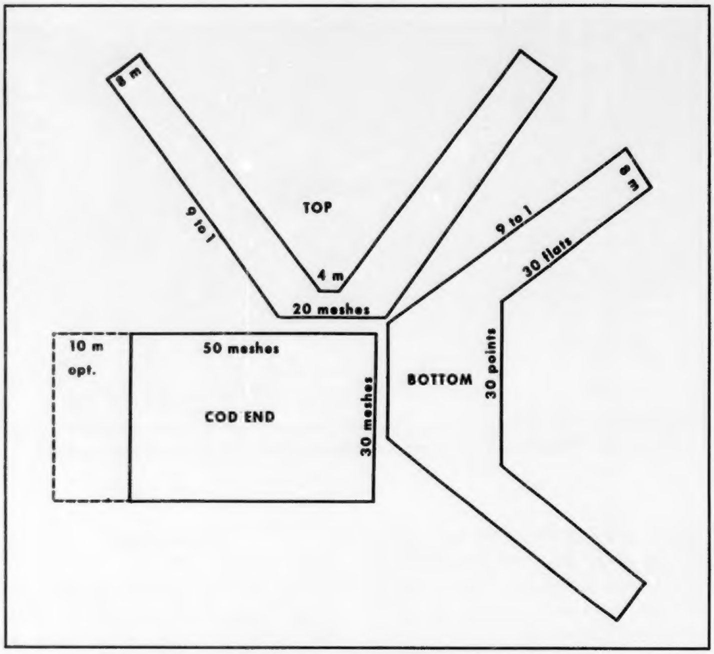


Figure 8.—Schematic diagrams of clam trawl, showing measurements.

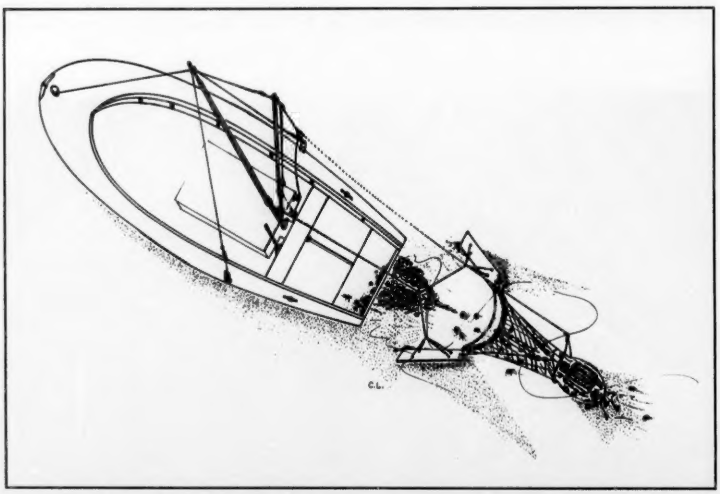


Figure 9.—Diagram of a boat rigged for harvesting clams with the clam trawl.

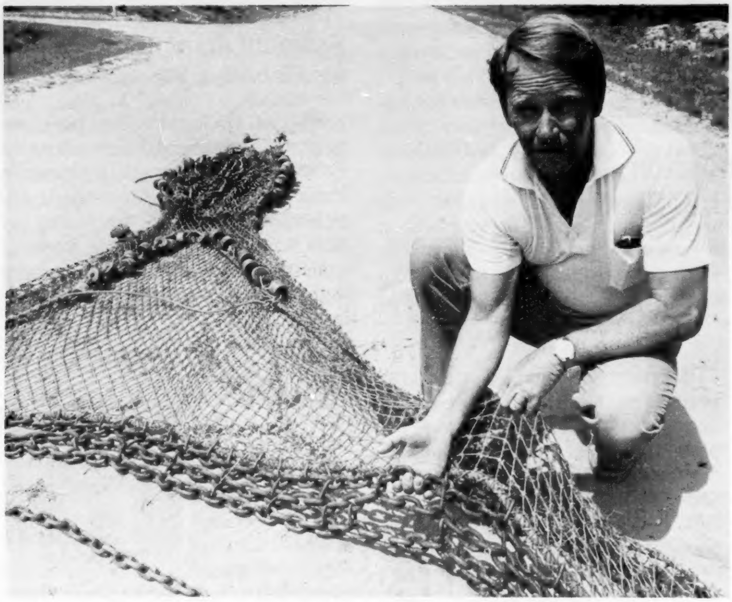


Figure 10.—Heavy anchor chain attached to lead line of a clam trawl.

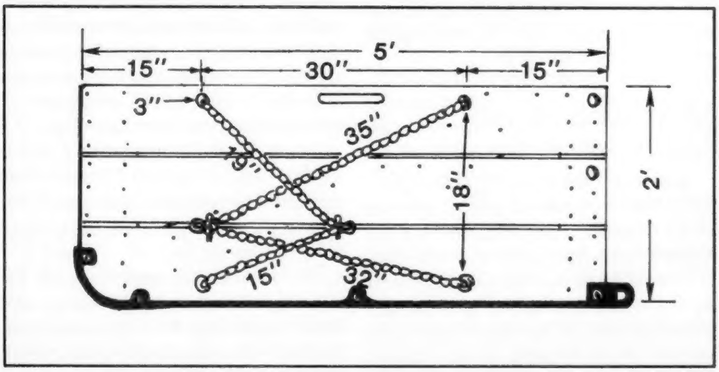


Figure 11.—Diagram showing how trawl board for clam trawl is rigged.

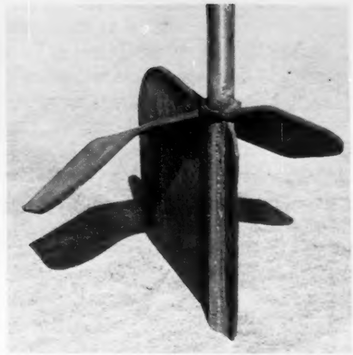


Figure 12.—The winged rudder, used to deflect propeller backwash to the bottom.

from the prop wash is deflected downward and compensates for the propeller not being the optimum angle or distance off the bottom.

Acknowledgments

We acknowledge the help and advice of many people. Most of them have used the various types of dredges, and some were the first to use a particular gear when it was introduced. All gave freely of their advice and helped in describing how the gear was actually used. Prominent among them are: Irvin Guthrie, Doug Guthrie, and Benjamin Brooks of Harkers Island; Monte Willis, Leslie Hamilton, Guy Hamilton, and Alfred Gaskill of Stacy; Harry Willis, James Stryon, and Alonzo Salter of Davis; and Henry Frost of Salter Path, N.C.

Literature Cited

Guthrie, J. F., R. L. Kroger, H. R. Gordy, and C. W. Lewis. 1973. The long-haul fishery of North Carolina. Mar. Fish. Rev. 35(12):27-33.

European Sales Mission, Exhibit Promote U.S. Seafood

United States seafood companies sold more than $1.4 million in products during a Commerce Department sponsored, 6-day sales mission to England, France, and The Netherlands in September, the National Oceanic and Atmospheric Administration (NOAA) reports.

Additional sales of $2-3 million were expected to follow, according to representatives of Clouston Foods Pacific Ltd. of Seattle; Golden Eye Seafoods of Fairhaven, Mass.; and Kachemak Seafoods, Inc., of Togiak, Alaska. Principal products sold were salmon, squid, dogfish, cod, king and snow crab, monkfish, and pollock.

"Many of the 150 buyers we met were interested in buying striped mullet, jack crevalle, snappers, spiny lobster, shrimp, freshwater eels, Arctic chars, smelts, and trouts, which the participating firms did not sell," William B. Folsom of NOAA's National Marine Fisheries Service (NMFS), which organized the effort, said.

And in October, nearly 80 species of American fish and shellfish, ranging from Alaskan pollock to yellow perch, were displayed today by 15 U.S. seafood firms and fishery development foundations at the opening of ANUGA '81 in Cologne, West Germany. ANUGA '81 was the largest international food show in the world with more than 6,000 exhibitors occupying more than 2 million square feet of space. Some 150,000 professionals from 80 countries visited the 14 exhibit halls before the show ended.

The Commerce Department's International Trade Administration and NOAA, in cooperation with the U.S. Embassy in Bonn, designed, built, and operated the U.S. seafood exhibition. "The exhibit permitted U.S. seafood exporters, producers, and processors to display their products to 6,000 to 12,000 professional food buyers from throughout the world," William B. Folsom, the seafood exhibit director of NMFS, said.

"U.S. fishermen landed 6.5 billion pounds of seafood products in 1980," Folsom noted. "Of this, more than 1 billion pounds, worth $1 billion, were exported. The United States has a potential of 22 billion to 33 billion pounds of renewable fishery resources within 200 miles of its coasts." Another seafood sales mission to The Netherlands is scheduled for February.

McManus Is Named NOAA General Counsel

Robert J. McManus, of Washington, D.C., has been named general counsel of the Commerce Department's National Oceanic and Atmospheric Administration (NOAA), NOAA Administrator John V. Byrne has announced. Immediately prior to joining NOAA, McManus was a partner in the Washington law firm of Whittlesey, McManus, and O'Brien. From 1971 to 1977 he was with the Environmental Protection Agency, first in the Office of General Counsel and subsequently as Director of the Oceans Division in the Office of International Activities.

A native of New York City, McManus was graduated from Yale College in 1961 and from Yale Law School in 1968, where he was a member of the Board of Editors of the Yale Law Journal. Between college and law school, he served as an officer in the U.S. Navy.

William G. Gordon Named Assistant Administrator for Fisheries

William G. Gordon has been appointed Assistant Administrator for Fisheries in the Commerce Department's National Oceanic and Atmospheric Administration (NOAA), according to NOAA Administrator John V. Byrne.

Gordon, who has held various fishery research and management positions during the past 25 years, directed the Resource Conservation and Management office within the National Marine Fisheries Service (NMFS) since 1979, and prior to that was Regional Director of the NMFS Northeast Region in Gloucester, Mass.

William G. Gordon

NOAA's Office of Fisheries manages and conserves the fishery resources within 200 miles of the U.S. coast, protects vital habitats and whales and other marine mammals, oversees programs to assist the economic development of the U.S. fishing industry, and conducts research to support these activities.

A native of Pennsylvania, Gordon holds an M.S. degree in Fisheries from the University of Michigan and a B.S. degree in Zoology from Mt. Union College.

He has fished commercially on the Great Lakes, other inland waters, and the North Atlantic. He is an avid camper, hunter, boater, recreational fisherman, and conservationist.

Commerce Department Sets Deep Seabed Mining Rules

Regulations that can open the way for exploratory mining of the ocean floor for valuable manganese nodules have been published in the *Federal Register*. The Commerce Department's National Oceanic and Atmospheric Administration (NOAA) worked more than 14 months to establish a licensing regime that gives American firms rights to explore ocean areas, primarily in the Equa-

torial North Pacific. These rights will be recognized by other seabed mining nations establishing compatible licensing regimes for their own citizens. Commercial mining of manganese nodules isn't expected to begin until the late 1980's.

At least four consortia of U.S. companies, including such firms as U.S. Steel, Lockheed Missiles and Space, Kennecott Corporation, Sedco, Sun Oil, and Standard Oil of Indiana, are expected to apply for licenses at a cost of $100,000 each. They already have spent several hundred million dollars on preliminary studies, development of mining technology, and exploration.

First discovered in 1873, manganese nodules occur in all the world's oceans and in some large lakes at depths of up to 18,000 feet. They contain substantial concentrations of copper, nickel, cobalt, and manganese. The United States imports almost all its nickel, cobalt, and manganese—metals that are crucial in the steel and aerospace industries. Manganese nodules can provide a stable supply of these metals at competitive prices, NOAA said.

The 1980 Deep Seabed Hard Mineral Resources Act grants NOAA authority to write mining regulations and issue licenses for both exploration and commercial recovery. Under this statute, a future Law of the Sea treaty dealing with deep seabed mining—if it were signed by the United States and ratified by the Senate—would take precedence over the NOAA rules. Such a treaty isn't expected for several years.

Outstanding NMFS Authors Honored

The outstanding papers authored by National Marine Fisheries Service scientists and published in the *Fishery Bulletin* and the *Marine Fisheries Review* for the years 1977 and 1978 have been announced.

For the *Fishery Bulletin* in 1977, William F. Perrin, David B. Holts, and Ruth B. Miller shared the award for their outstanding paper "Growth and Reproduction of the Eastern Spinner Dolphin, a Geographical Form of *Stenella longirostris* in the Eastern Tropical Pacific," 75(4):725-750. The authors are with the NMFS La Jolla Laboratory, Southwest Fisheries Center, La Jolla, Calif.

Selected as the best paper in 1977 in the *Marine Fisheries Review* was "Development of an Aquacultural Program for Rehabilitation of Damaged Oyster Reefs in Mississippi," by Clyde L. MacKenzie, Jr., 39(8):1-13. MacKenzie is with the NMFS Sandy Hook Laboratory, Northeast Fisheries Center, Highlands, N.J.

Chosen as the outstanding paper in the *Fishery Bulletin* for 1978 was "Trophic Relationships Among Fishes and Plankton in the Lagoon at Enewetak Atoll, Marshall Islands," by Edmund S. Hobson and James R. Chess, 76(1):133-153. Both authors are with the NMFS Tiburon Laboratory, Southwest Fisheries Center, Tiburon, Calif.

And, J. Perry Lane's "Eels and Their Utilization" was selected as the outstanding paper in the 1978 issues of *Marine Fisheries Review*, 40(4):1-20. Lane is with the NMFS Gloucester Laboratory, Northeast Fisheries Center, Emerson Ave., Gloucester, Mass.

Developed in 1975, the annual publication awards program recognizes NMFS employees who have made outstanding contributions to the knowledge and understanding of the resources, processes, and organisms studied as a part of the NMFS mission.

Fishery Bulletin papers must document outstanding scientific work while *Marine Fisheries Review* papers must be effective and interpretive contributions to the understanding and knowledge of NMFS mission-related studies.

Any NMFS employee may recommend publications of the appropriate calendar year for award consideration. Authors must have been employed by the NMFS at the time the paper was published. Nominations must include the author's name, paper title and number of pages, series name and/or volume, justification to support the nomination, and the name and office affiliation of the nominator.

Florida Gets $2.6 Million Coastal Program Award

The Commerce Department has approved a coastal management program for Florida and allocated $2.6 million for the first year of the program, the National Oceanic and Atmospheric Administration (NOAA) has announced. The approval coincided with Florida's initiation of a comprehensive "Save Our Coasts" effort. This includes using new State bonds to increase beach acquisition, reviewing State coastal protection activities, and directing State agencies to give special consideration to hurricane hazards.

About $520,000 of the NOAA award will support hurricane hazard activities and funding development of hurricane evacuation and shelter plans for south Florida. Another $625,000 will be used for dredging and spoil disposal plans for the ports of Jacksonville, Tampa, and Pensacola; another $550,000 has been allocated for local governments, regional planning councils, and water management district projects.

Florida is the 26th State to get federal approval, and financial support, for coastal management programs. NOAA officials said 87 percent of the U.S. coastline is covered by federally approved, State-run programs.

In addition to today's award, Florida has received special grants totalling $500,000 under NOAA's Coastal Energy Impact Program to help coastal counties and communities deal with the effects of coastal energy development. These grants have included $36,000 to study oil pollution on rivers; $85,600 to investigate energy development impact on the Big Bend area, and $305,000 to determine the best sites for onshore support facilities associated with offshore oil and gas development.

The Fisheries and Fish Trade of Portugal

Portugal has a long seafaring tradition and 500 miles of coastline. However, fishing provides only about 1 percent of that nation's GNP and directly employs only 1 percent of the labor force. Nevertheless, the Portuguese have a stronger attachment to fish than these statistics would indicate.

Another 2-3 percent of the labor force is employed in fisheries related activity (canning, cold storage, etc.). And the Portuguese rely heavily upon fish for their protein requirements (annual per capita fish consumption in 1977 was over 29 kilos) and for export earnings (US$98.4 million in 1979). The industry is characterized by lack of capital and innovation and by persistence of traditional methods, often artisanal. Opportunities for foreign sales to Portugal and investment in Portuguese industry are expected to grow in the next few years.

Portuguese Fishing

The Portuguese fishing fleet is old, primitive, and limited in capacity (Table 1, 2). Of the 17,891 fishing vessels registered in continental Portugal at the end of 1978, only 9,635 were in service. Of these only 4,200 had motors, with 3,526 of them being under 25 gross tons capacity. Even those registered as being in service have much down time due to labor stoppages, mechanical difficulties or other problems, averaging only 180 days at sea per year.

Table 1.—Total fishing fleet in metropolitan Portugal,[1] 1960-1978.

Year and status	Motorized		Nonmotorized	
	Number	Gross tonnage	Number	Gross tonnage
Registered[2]				
1960	2,864	132,291	15,213	21,316
1965	3,738	146,033	14,854	21,326
1970	4,205	174,991	13,378	18,632
1971	4,116	168,501	13,337	18,639
1972	4,064	172,582	13,048	17,409
1973	4,185	180,202	12,759	16,828
1974	4,152	177,683	12,521	15,913
1975	4,814	181,652	11,946	14,799
1976	5,161	180,938	11,763	14,031
1977	5,372	201,466	12,325	14,418
1978	5,567	206,852	12,324	14,599
In service[3]				
1960	2,321	125,821	8,673	11,922
1965	3,136	136,502	7,938	11,312
1970	3,421	147,631	6,543	8,522
1971	3,324	141,470	6,023	7,613
1972	3,250	134,578	5,984	8,043
1973	3,295	143,139	6,043	8,045
1974	3,103	149,052	5,548	6,244
1975	3,508	152,238	5,715	6,431
1976	3,597	156,123	5,170	5,749
1977	3,770	154,387	5,644	6,488
1978	4,200	157,646	5,435	6,087

[1] Includes continental Portugal, Azores, and Madeira.
[2] On 31 December.
[3] On 31 July.

Table 2.—Fishing fleet by tonnage in metropolitan Portugal in 1978[1].

Vessel size and status	Total		Motorized		Nonmotorized	
	Number	Gross tonnage	Number	Gross tonnage	Number	Gross tonnage
Registered[2]						
Up to 5 tons	15,206	19,999	3,006	6,507	12,200	13,492
5 to 25 tons	1,767	19,050	1,645	18,005	122	1,045
25 to 50 tons	451	15,431	449	15,369	2	62
50 to 100 tons	209	13,859	209	13,859	–	–
Over 100 tons	258	153,112	258	153,112	–	–
Total	17,891	221,451	5,567	206,852	12,324	14,599
In service[3]						
Up to 5 tons	7,669	10,566	2,262	4,666	5,407	5,900
5 to 25 tons	1,292	13,873	1,264	13,686	28	187
25 to 50 tons	322	11,149	322	11,149	–	–
50 to 100 tons	148	9,537	148	9,537	–	–
Over 100 tons	204	118,608	204	118,608	–	–
Total	9,635	163,733	4,200	157,646	5,435	6,087

[1] Includes continental Portugal, Azores and Madeira.
[2] On 31 December.
[3] On 31 July.

Table 3.—Number of fishermen registered on 31 December 1978 in metropolitan Portugal[1].

Year	Total	By age		By type of fishery			
		Over 21 years	Less than 21 years	Cod	Sardine	Trawler	All other
1960	32,010	n.a.[3]	n.a.	n.a.	n.a.	n.a.	n.a.
1965	38,550	34,592	3,958	n.a.	n.a.	n.a.	n.a.
1970	33,594	30,570	3,024	1,972	8,562	1,917	21,143
1971	34,040	30,799	3,241	2,078	8,397	3,258	20,307
1972	33,034	29,392	3,642	1,995	8,290	3,614	19,135
1973	29,426	25,999	3,427	2,492	4,663	2,540	19,731
1974	30,621	27,658	2,963	2,961	5,024	3,290	19,346
1975	28,883	26,059	2,824	1,477	3,677	2,088	21,641
1976	31,754	28,785	2,969	2,353	4,547	3,328	21,526
1977	30,991	27,975	3,016	2,628	6,191	3,543	18,629
1978	32,251	29,592	2,659	2,356	5,384	2,351	22,160

[1] Includes continental Portugal, Azores, and Madeira.
[2] Available only for continental Portugal.
[3] n.a. = not available.

The number of registered fishermen (Table 3), 32,251 as of 31 December 1978, has remained steady over the past few years, but the average age has increased as youth tend to enter more lucrative crafts. In volume, Portugal's catch has been cut in half in recent years, going from 424,482 metric tons (t) in 1965 to only 211,824 t in 1979 (Table 4, 5). In value, both imports and exports more than tripled between 1970 and 1979 (Table 6, 7).

Government Agencies

After the Revolution of 25 April 1974, primary fishing responsibilities were transferred from the Navy Ministry to the Ministry of Agriculture and Fisheries (MAP). Within the MAP, overall policy direction is provided by the State Secretariat for Fisheries and its subordinate organization, the Directorate General for Fisheries. The latter has departments or subagencies concerned with international relations, development and coordination of the fishing industry, renovation and reequipment of the fishing fleet, oversight of fish canning, statistics and analysis, and research and investigation.

The Ministry of Commerce and Tourism (MCT) also has a strong role in fisheries through its Commission to Regulate the Commerce of Codfish (CRCB). The CRCB has the import monopoly for codfish and hake and licensing authority for other fish imports. It sets retail prices on some imported fish and allocates quotas on them to wholesale distributors. It has wide latitude in making its decisions. It can, for example, forbid permission to import a certain fish if it believes the country does not need it, even if a private importer is willing to buy it.

In the aftermath of the Revolution, the state nationalized the three largest fishing companies (Companhia Portuguesa de Pesca, Sociedade Nacional dos Armadores de Pesca do Arrasto, and Sociedade Nacional dos Armadores de Bacalhau) and three large marketing firms (Gelmar, Friantarticus, and Docapesca).

Table 4.—Volume (t) and value (millions of escudos) of fish catches in metropolitan Portugal[1], 1960-79.

	Saltwater fish		Shellfish		Mollusks		Other		Total	
Year	Volume	Value	Volume	Value	Volume	Value	Volume	Value	Volume	Value
1960	346,824	1,524	771	22	6,547	25	433	4	354,575	1,575
1965	414,955	1,756	949	40	8,486	44	592	6	424,982	1,846
1970	355,148	2,087	825	69	9,016	65	434	4	365,423	2,225
1971	336,240	2,549	529	55	10,902	140	534	9	348,205	2,753
1972	329,282	2,593	847	55	12,205	175	383	10	342,717	2,833
1973	362,876	3,143	797	59	11,353	138	387	10	375,413	3,350
1974	288,980	3,736	775	51	7,228	153	315	12	297,298	3,952
1975	276,446	4,034	385	30	8,356	197	245	10	285,432	4,271
1976	277,403	6,095	255	36	8,656	293	254	15	286,568	6,439
1977	281,853	7,444	101	15	8,424	395	487	37	290,865	7,891
1978	244,186	9,003	111	22	10,520	526	311	31	255,128	9,582
1979[2]	206,392	9,179	260	78	5,028	539	144	13	211,824	9,809

[1]Includes continental Portugal, Azores, and Madeira.
[2]Preliminary.

Table 5.—Major fish catches landed in metropolitan Portugal[1], 1976 through 1979, by volume (t) and value (1,000 escudos).

	1976		1977		1978		1979[2]	
Species	Volume	Value	Volume	Value	Volume	Value	Volume	Value
Saltwater fish								
Tunas	6,146	79,840	9,431	175,911	5,099	149,240	1,702	68,127
Cod	40,305	1,310,591	34,813	1,814,042	30,190	1,994,117	20,426	1,613,421
Chinchards (large & sm.)	52,127	752,678	54,596	982,373	35,994	1,216,263	31,592	1,460,222
Scabbard	6,542	301,622	7,512	418,767	7,728	569,050	n.a.[3]	n.a.
Whiting	27,122	1,213,139	15,877	926,699	19,271	1,166,560	5,663	968,692
Sardines	79,246	625,131	79,823	754,308	83,600	1,186,008	90,954	1,300,152
Sp. mackerel	9,417	55,343	11,639	70,498	8,749	121,517	n.a.	n.a.
Anchovy	88	925	3,261	33,901	1,022	14,019	n.a.	n.a.
Other	56,408	1,755,565	64,901	2,267,289	52,533	2,586,214	n.a.	n.a.
Total	277,403	6,094,834	281,853	7,443,788	244,186	9,002,988	206,392	9,179,175
Shellfish								
Lobsters	57	13,959	32	7,018	49	12,643	n.a.	n.a.
Shrimp	26	4,728	19	3,477	25	6,425	n.a.	n.a.
Other	172	17,185	50	4,287	37	3,388	n.a.	n.a.
Total	255	35,872	101	14,782	111	22,456	260	77,512
Mollusks								
Squid	668	48,426	1,084	94,695	726	93,640	n.a.	n.a.
Cuttlefish	944	55,115	1,434	84,192	1,515	113,731	n.a.	n.a.
Oysters	138	2,906	–	–	–	–	n.a.	n.a.
Octopus	4,665	158,132	3,613	182,343	6,712	284,653	n.a.	n.a.
Other	2,241	29,119	2,293	33,795	1,567	34,268	n.a.	n.a.
Total	8,656	293,698	8,424	395,025	10,520	526,292	5,028	538,912
Other	254	14,789	487	37,628	311	30,648	144	13,519
Grand total	286,568	6,439,193	290,865	7,891,223	255,128	9,582,420	211,824	9,809,118

[1]Includes continental Portugal, Azores, and Madeira.
[2]Preliminary.
[3]n.a. = not available.

Table 6.—Foreign trade of fishery products in metropolitan Portugal[1] in millions of escudos and U.S. dollars (conversion rates given at end of text).

	Imports		Exports		Balance	
Years	Esc.	US$	Esc.	US$	Esc.	US$
1960	204	7.1	1,152	40.0	948	32.9
1965	359	12.5	1,617	56.1	1,258	43.6
1966	488	16.8	1,491	51.4	1,003	34.6
1967	950	32.9	1,490	51.6	540	18.7
1968	534	18.6	1,484	51.6	950	33.0
1969	697	24.4	1,360	47.6	663	23.2
1970	936	32.7	1,341	46.9	405	14.2
1971	1,404	49.8	1,261	44.7	-143	-5.1
1972	1,668	61.8	1,401	51.9	-267	-9.9
1973	1,644	66.6	1,623	65.8	-21	-0.8
1974	2,658	104.6	1,427	56.2	-1,231	-48.4
1975	2,670	104.5	1,476	57.8	-1,194	-46.7
1976	3,315	109.7	1,815	60.1	-1,500	-49.6
1977	3,329	87.0	2,659	69.5	-670	17.5
1978	1,940	44.2	3,527	80.3	1,587	36.1
1979[2]	3,742	76.5	4,816	98.4	1,074	21.9

[1]Includes continental Portugal, Azores, and Madeira.
[2]Preliminary.

Table 7.—Foreign trade of major fishery products in metropolitan Portugal[1] in millions of escudos, 1960-1979.

Item	1960	1965	1970	1975	1976	1977	1978	1979[2]
Imports								
Fresh or frozen fish	115	60	148	1,625	1,873	1,971	882	2,560
Salted, dried, or smoked fish	78	267	620	591	809	903	754	686
Crustaceans and mollusks	5	3	49	241	375	179	44	174
Canned fish	2	5	9	14	9	4	7	4
Fish oil	—[3]	1	—[3]	8	2	1	1	—[3]
Fish meal	4	23	110	191	247	271	252	318
Total	204	359	936	2,670	3,315	3,329	1,940	3,742
Exports								
Fresh or frozen fish	41	51	85	127	124	187	5	469
Salted, dried, or smoked fish	5	9	7	11	5	10	31	41
Crustaceans and mollusks	14	56	94	58	78	109	144	236
Canned fish	1,048	1,433	1,082	1,221	1,544	2,265	3,269	3,901
Fish oil	37	58	53	40	59	88	78	131
Fish meal	7	10	20	19	5	—	—	38
Total	1,152	1,617	1,341	1,476	1,815	2,659	3,527	4,816
Trade balance (deficit)	948	1,258	405	-1,194	-1,500	-670	1,587	1,074

[1]Includes continental Portugal, Azores, and Madeira.
[2]Preliminary.
[3]Less than Esc. 500,000.

Fishing Industry Problems

Some of the old problems include: An emphasis upon preservation of a traditional way of life as opposed to adoption of new methods of operation; limited income expectations of fishermen; inadequate or poorly located shore facilities such as docks, refrigerated warehouses, and distribution centers; an inefficient auction system for initial sale of a catch; and lack of vocational, professional, and scientific training and research.

The 1974 Revolution brought with it some new problems. The role of the state in the industry increased greatly but the bureaucracy is ill equipped to deal with its new responsibilities. There are some very competent fishing officials at the top, but they are spread quite thin. Top fishing officials turn over more frequently than desired, and complain about lack of cabinet-level attention on fisheries.

The fishing firms that were nationalized were taken over almost accidentally because they were owned by banks that were themselves nationalized. There does not appear to have been an intent to coordinate more effectively the operations of these fishing firms, which continue to go their separate ways.

There is a built-in contradiction in their operations. Governments freeze some food prices for political reasons, including a few species of fish. For example, the domestic retail price for the Portuguese mainstay, cod, has been fixed since 1978. A state-run firm fishes for cod, pays ever-increasing prices for its fuel and equipment, and then sells its catch in Portugal at the controlled domestic prices. Consequently it runs at a loss and lacks capital for modernization. In addition, the firms suffer from featherbedding, frequent labor disputes, lack of a regular mechanism for resolving these disputes, low vessel utilization, insufficient refrigeration and freezing facilities, excessive ratio of personnel costs to other costs, and technological obsolescence.

Note: Unless otherwise credited, material in this section is from either the Foreign Fishery Information Releases (FFIR) compiled by Sunee C. Sonu, Foreign Reporting Branch, Fishery Development Division, Southwest Region, National Marine Fisheries Service, NOAA, Terminal Island, CA 90731, or the International Fishery Releases (IFR) or Language Services Biweekly (LSB) reports produced by the Office of International Fisheries Affairs, National Marine Fisheries Service, NOAA, Washington, DC 20235.

Portuguese fishing also suffers from problems beyond Portuguese control such as soaring fuel and equipment costs; depletion of fish stocks (particularly of hake, sardines, and mackerel on the continental shelf); increased protectionism in foreign countries off whose shores the Portuguese traditionally fish (i.e., Canada, Mauritania, and Norway); and increased competition from other countries, such as Spain, which wish to fish waters previously dominated by the Portuguese.

Government Program in Fisheries

The Democratic Alliance (AD) Government, which took office in January 1980 and faced elections in October 1980, called for the following in its comprehensive governmental program: 1) Negotiating new accords with foreign countries to increase fishing zones (Note: the Portuguese Government revived fishing negotiations with the United States which had been dormant since June 1978); 2) modernizing fishing vessels and building new ones in national shipyards; 3) strengthening the National Fish Research Institute (INPI) to obtain more information about the resources of Portugal's 200-mile Exclusive Economic Zone; 4) improving fish processing and marketing and making greater use through oils and fish meal of species that are less desirable for human consumption; and 4) establishing permanent contact between the Ministry of Agriculture and Fisheries and other ministries involved in the buying, selling, and processing of fish.

The Government also instituted under its Integrated Investment Incentive System fiscal and financial incentives available to foreign and domestic investors in several priority sectors, of which fishing is one (Lisbon 5624, July 1980).

Improvement Potential

Thoroughgoing reform is required to reverse the decline in the Portuguese fishing industry. Many fish officials would like to see a separate fish ministry which would give greater priority to the role of

fishing in the Portuguese economy and consolidate functions that now come under several ministries. If the major fishing firms are to remain under state control, central direction of their operations would help minimize waste, duplication, and expense. The prices of the few types of fish controlled by the government might also be freed to break the circle of static income, soaring costs, and increased debt. At the moment there are several different labor unions involved in the fishing industry and the agreements signed are often uneconomic and prone to misinterpretation. Labor reform is therefore essential.

Opportunities for U.S. Businessmen

Opportunities exist for sales of engines, radar, fish processing and packaging equipment, communication equipment, navigational aids, depth sounders, and specialized gear. Portugal is an important purchaser as well as catcher of fish, and Government fishing officials recently identified the following species caught by U.S. fishermen as being of particular interest to Portuguese importers: Alaska pollock, ocean perch, Pacific and other cod, silver hake, and chub mackerel.

They also expressed an interest in joint ventures, including those involving duty-free entry into Portugal of U.S.-caught fish for processing and subsequent exporting to the rest of Europe. This possibility should be particularly attractive when Portugal joins the EEC, now scheduled for 1983.

Exchange rates used in this report are: for 1960 and 1965 (US$1=Esc.28.83); 1966 (28.98); 1967 (28.86); 1968 (28.77); 1969 (28.561); 1970 (28.590); 1971 (28.211); 1972 (27.011); 1973 (24.673); 1974 (25.408); 1975 (25.553); 1976 (30.223); 1977 (38.278); 1978 (43.940); and 1979 (48.924). (Source: IFR-81/115.)

Australia's 1980-81 Tuna Harvest Sets New Record

Australia's 1980-81 tuna catch was a record, according to an *Australian Fisheries* report. At the end of March landings were close to 16,000 metric tons (t)—28 percent higher than the last season's total catch and 18 percent above the previous record in 1972-73.

Catches rose in all States. The New South Wales catch at the end of March 1981 was 4,700 t, up 30 percent from the previous season. Of this, some 1,200 t was skipjack tuna and further landings of up to 500 t were expected before the end of the season.

Landings in South Australia to the end of March were 7,800 t, up 22 percent from the previous year. In Western Australia the catch to the end of March was 2,500 t, sharply up from previous years. Further landings of southern bluefin tuna and skipjack were expected in both States.

Prices

Opening season prices were also at record levels. Southern bluefin tuna brought $875/t, $25 above the last season's peak. Skipjack tuna prices started at $775/t, compared with $550 in the previous season. These high prices were a result of good overseas prices, low catches at the beginning of the season, and a shortage of tuna for canning.

However high catches since then, increased imports, and a fall in overseas demand left Australian canners holding record stocks of tuna. In early April this had not affected the price paid to fishermen for southern bluefin tuna but skipjack tuna prices had fallen to $625/t for fish over 2 kg and $425/t for fish under 2 kg. One cannery in Western Australia stopped buying tuna in early April.

Imports

Tuna imports were also running at record levels in 1980-1981. Imports of canned tuna for the 8 months to February 1981 were 1,745 t (product weight), up 6 percent for the same period during last year, when imports were a record. These supplies had come mainly from New Zealand, the Philippines, Thailand, and Japan. Whole tuna imports for the same period were 1,120 t (live weight).

Overseas Market

The record Australian catch coincided with good landings by European countries and increased competition on the Italian market. Italy is Australia's principal market for frozen whole tuna, and during the previous year nearly all Australian exports of just over 6,000 t went there.

However prices in Italy fell in the first few months of 1981. For example, the price of yellowfin tuna in early April was down to US$1,540/t, US$1,000 less than last year's price. The price declines had been due to good catches by the Spanish and French fleets and increased imports from Mexico.

Although the Italian market had become more competitive, Australian exporters had still been able to ship tuna there. In the 8 months to February 1981, exports totalled 880 t at an average value of $1,380/t. In the same period last year, 2,214 t of tuna were exported to Italy at $1,060/t. Close to 600 t were sent to Italy in March.

Local Market

On the Australian market, increased prices to fishermen resulted in much higher prices for canned tuna over the past 2 years and consumers have bought less. In an effort to reduce their stocks some canners lowered their wholesale prices of canned tuna during March.

French Fishermen Try Sail-Powered Catamarans

A French skipper, Charles Villalon, has launched a new boat, the *Diogenes*, near Saint Malo, France, the first sail-equipped catamaran built in that country for fishing with nets and traps. It was soon joined by a sister ship, the *Dar-Mad*, built for another French skipper.

Both vessels are 17 m, aluminum alloy catamarans propelled by a combination of motors and sails. Each of the catamaran's hulls holds a 150 hp motor that turns an aluminum screw. Combined, the two motors can provide an estimated speed of 14 knots. Under good weather conditions, the skippers can count on using the wind as either the sole or a supplementary power source. A 14 m mast behind the cabin can carry two sails: a 50 m^2 Genoa sail and a 25 m^2 main sail. (Source: LSB 81-27.)

The Fishing Industry of Kyushu, Japan

The fishing industry in Kyushu, Japan's southernmost island, is having difficulty because of declining catches. Although some Kyushu fishermen may, as a result, be in for a period of economic hardship, the reduced catch may well bring about a much greater local interest in fishery imports from the United States, and in joint ventures with U.S. fishing companies which would allow Kyushu fishermen to gain access to the U.S. 200-mile fisheries zone.

Background

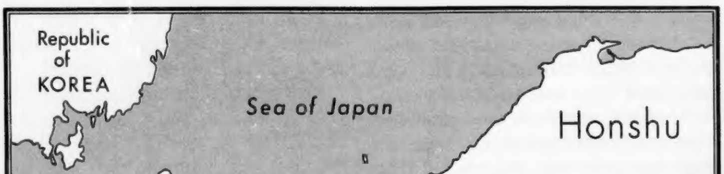
The fishing industry is important on Kyushu even though fishermen themselves account for only 2 percent of total employment. The fishermen and processing plants are important to many coastal communities and support many marine supply businesses. Besides their economic importance, the Kyushu fishermen also wield local political influence out of proportion to their ranking in industrial statistics.

Fishing is still a traditional occupation on Kyushu with its lengthy ragged coastline and almost 750 designated fishing ports. Kyushu fishermen account for nearly 20 percent of the total Japanese catch by quantity and slightly more by value. The industry is most important in Nagasaki Prefecture, where fishermen alone constitute 6 percent of total employment. Nagasaki accounts for over 40 percent of Kyushu's catch, followed by Fukuoka Prefecture with 20 percent. Other coastline prefectures divide the remainder about equally. There is considerable variation between the prefectural fleets. A higher percentage of the Fukuoka-based fleet is comprised of modern deep-sea vessels producing relatively high-volume catches of such fish as tuna and bonito. The Oita and Miyazaki fleets also tend to specialize in high-value tuna. The large Nagasaki fleet, however, is more of a coastal operation, producing high-volume catches of such lesser-value fish as sardine, squid, and mackerel. For somewhat different reasons, both groups—the deep-sea and the coastal fishermen—experienced problems in 1981.

Current Problems

About a decade ago, the Kyushu fishing industry went through a period of consolidation. During 1973-78, both the employment and the number of vessels appeared to stabilize. However, the catch from the waters around Kyushu in 1980 and early 1981 was estimated to be only 80 percent of the average for the previous 5-year period—amounting perhaps to only 1.3 million t. Local scientists have attributed this to the declining biomass of commercial fish stocks in local waters caused by temporary shifts in currents.

Small-scale coastal fishermen have so far not yet suffered severe hardship because price increases have tended to offset lower catch. One other important side effect has been that porpoises, which feed on many species caught by the local fishermen, had, by and large, either stayed away in 1981 or were feeding on commercially less valuable fish. This had



eliminated their roundup and slaughter by Kyushu fishermen, such as the incident off Iki Island in 1981 which caused intense international publicity and criticism.

Deep-sea fishermen face problems of a different nature and probably of longer duration. Some companies have been affected by the shortage of fish in Kyushu waters, and all have been affected by rising fuel costs when fishing on distant grounds. An even more telling blow will soon be dealt to those companies which have fished in the East China Sea. An agreement, which took effect 1 April 1981, between the Republic of Korea and Japan will result in reduced access of Kyushu fishermen to East China Sea fishing grounds. (In return, reduced access by Korean fishermen to grounds off Hokkaido was negotiated.) Of 240 Kyushu vessels that until now have fished in the East China Sea area subject to the new agreement, 66 will be denied access in the future. Only 20 or 30 boats per month will be allowed to fish on the best grounds. Local sources predicted that the beginning of a shakeout of the fishing companies, especially those that are not vertically integrated, would begin in May 1981. Two fair-sized Fukuoka companies had already entered receivership, even before the Japan-Korea agreement took effect, reflecting the debilitating effects the other factors have had on the companies' financial strength.

New Initiatives

There have been several responses to these developments. Small-boat fishermen are reported to be displaying greater interest in fish farming, already strong in certain areas of Kyushu such as Kagoshima Prefecture. The deep-sea fishermen are looking for alternate fishing grounds, and in the past few months several Japanese companies have inquired about laws and regulations that would apply if they were to establish U.S.-based joint venture companies. One of these projects appears to be quite far along and may result in relatively substantial investment in facilities in Guam. Companies closer to the consumer in the distribution channel, particularly fish processors, are expected to increase their already strong interest in finding good supply sources of imported fish to compensate for reduced supplies available from Japanese fishermen.

According to the NMFS Foreign Fisheries Analysis Division, the current problems of the Kyushu fishing industry may well lead to a resumption of its long-term decline and create hardship for some individual fishermen and fishing companies. These problems, however, also appear to be conducive to both increased Japanese investment in the U.S. fishing industry and increased sales opportunities for United States fishery exporters. (Source: IFR-81/113.)

Norway Sees Increase in Illegal Fishing

Foreign fishing vessels were seen carrying out extensive illegal fishing in 1981 in Norway's territorial waters, the Norwegian Information Service reports. The Norwegian Coast Guard had by 20 October, apprehended 36 vessels—more than twice as many as in all of 1980. The aggregate sum resulting from the imposition of fines and the confiscation of catches was US$533,000.

One very surprising aspect of these illegal activities was that all the boats apprehended were in the North Sea, south of Stadt on the coast of west Norway, whereas the majority of infringements in 1980 occurred in northerly waters. Commodore Nils Tiltnes of the Norwegian Coast Guard ascribed the increasing illegal activities in southerly waters to diminished respect for Norwegian fisheries regulations. In addition to the 36 boats which were apprehended, 15 were ordered to leave the Norwegian zone while 181 were given written warnings or comments. The most common form of infringement was the use of illegal tackle. Another frequent occurrence was unsatisfactory reporting of the catch.

The situation in more northerly waters was slightly better, although 125 written cautions had also been issued in this area. Commodore Tiltnes stated that surveillance work in the north has improved, making it more hazardous to take chances. The Coast Guard in north Norway had recently taken over six new helicopters to augment its squadron at Bardufoss. These helicopters, three newly built special vessels, and three aircraft now form the cornerstones in a radically improved patrol potential in these waters.

FAO Starts Fish Market Service for Asia, Pacific

The Food and Agriculture Organization of the United Nations has established a fish marketing information and advisory project in Kuala Lumpur, Malaysia, to help nations in the Asia and Pacific region develop their fishing industries. Called INFOFISH, the project is funded by the Norwegian Government, with the Government of Malaysia hosting the project and supplying accommodation and support staff. The project is headed by Wolfgang Krone, formerly chief of FAO's Fish Utilization and Marketing Service in Rome. Fifteen nations are participating members at the outset and five more are expected to join.

As one service, INFOFISH will put Asia/Pacific region exporters and producers of fish in touch with potential buyers in markets throughout the world, using telex and other links. INFOFISH will pay particular attention to stimulating fish trade between nations within the region, and to finding markets for species not commonly marketed at present but which are available in great abundance in the area.

The FAO project will keep member countries supplied with advisory notices and other news about developing market trends through a fortnightly trade newsletter. It will also publish a bimonthly magazine, *INFOFISH Marketing Digest*, carrying technical advice, news about equipment and processing trends, and the results of studies of Asia/Pacific marketing issues commissioned by INFOFISH. INFOFISH will also supply on-the-spot marketing advice on request to member nations.

A similar FAO service, INFOPESCA, has served Latin American and Caribbean nations since 1977 and helped close transactions worth $225 million in the first half of 1981 alone.

Foreign Participation in Brazilian Fish Industry

Brazil has enacted restrictive regulations governing foreign companies operating in Brazil. Even so, Brazilian officials maintain that they would like to see increased foreign participation in the fishing industry if it would promote development. Officials of Brazil's fisheries agency, the Superintendency for the Development of Fisheries (SUDEPE), and the Interministerial Commission for Ocean Resources (CIRM) recently reviewed Brazilian regulations governing joint ventures and foreign fishermen. A synopsis of these regulations follows.

Joint Ventures

Foreign investors are only allowed minority interest in joint venture companies. The minority interest, however, is calculated on the basis of the total assets of the joint venture, i.e., both vessels and processing plants. Vessels operated by the joint venture companies do not have to be transferred to Brazilian registry and can fly their flag of origin.

Vessel Leasing

Brazilian companies frequently charter foreign fishing vessels for both exploratory and commercial fishing. Vessels so chartered can be wholly owned by the foreign companies and may also continue to be registered abroad.

Vessel Crews

Under current Brazilian law, two-thirds of the fishing vessel crew must be Brazilian. SUDEPE reports, however, that this is subject to interpretation, depending on the Labor Ministry's assessment of the availability of Brazilian crewmen. No current regulations require that the captain or technical personnel must be Brazilian. Naval officials, however, state that companies should make an effort to recruit Brazilian captains and technicians.

Corporate Income Taxes

Brazilian companies are required to pay about 35 percent of their profits annually to the Brazilian Government. The Government has, however, implemented special tax regulations to encourage investment in "neglected or insufficiently exploited" industries. The Government has classified fisheries as such an industry, and as a result, fishing companies qualify for tax incentives. Companies can allocate part of their normal tax payments for "shares of entitlement" which permit the companies to reduce their taxes by as much as 25 percent.

Repatriation of Profits

There are no limitations on the repatriation of profits by foreign-owned companies, other than a Brazilian withholding tax. The tax for companies repatriating up to 36 percent of their registered capital[1] over a 3-year period is 25 percent. The tax increases if repatriated profits exceed 36 percent of the company's registered capital. Repatriated profits of 37-41 percent are taxed at 40 percent, 42-61 percent at 50 percent, and 62-100 percent at 60 percent.

Landing Requirements

All fish caught in Brazilian waters must be landed in a Brazilian port before being exported. SUDEPE reports that Belem, which once had very limited port facilities, now has sufficient facilities for cold storage, grading, and processing of fish and shellfish. (Belem is Brazil's major northern shrimp port. United States and other foreign fishermen previously fished off Belem until the Brazilian Government phased out foreign participation in the shrimp fishery.)

[1]The 36 percent is net of the withholding tax; the gross amount would be 48 percent.

Fuel

SUDEPE reports that under an agreement with the National Petroleum Council, all fuel needed by the fishing industry will be provided. There are no quotas. SUDEPE also stated that an interministerial meeting has been convened to consider a proposal to provide a 30 percent subsidy for diesel fuel (based on prices prevailing through 24 June 1981) for export-oriented fisheries. According to SUDEPE, the high cost of fuel has seriously reduced the profit margins for most fishermen. One SUDEPE official pointed out that most of the receipts from the sale of the average trawler catch go to pay for operating costs, especially fuel costs. A typical Brazilian trawler owner reports a catch of about 10 t of shrimp per year. Of that amount, approximately 6 t is currently required to cover operating costs. If the 30 percent subsidy were granted, only about 3 t would be consumed by operating costs. SUDEPE officials pointed out that the subsidy proposal is an example of the priority Brazil is placing on fisheries development.

Spare Parts

CIRM reports that there is frequently a long time lag involved between ordering and receiving imported spare parts because of a general policy administered by the Department of Foreign Trade (CACEX) which attempts to hold imports to a minimum.

Many U.S. companies have reported considerable difficulty conducting business in Brazil. Even so, Brazilian officials stated that in the past year, private U.S. participation in the fishing industry has increased. Cooperation agreements have been initiated in both the tuna and scallop fisheries. A U.S. company has made additional investments in the sardine fishery and another U.S. company has leased 40 Korean (ROK) trawlers to participate in the northern shrimp fishery out of Belem. (Source: IFR-81/127.)

New NMFS Scientific Reports Published

The publications listed below may be obtained from either the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402, or from D822, User Services Branch, Environmental Science Information Center, NOAA, Rockville, MD 20852. Writing to the agency prior to ordering is advisable to determine availability and price, where appropriate (prices may change and prepayment is required).

NOAA Technical Report NMFS SSRF-747. Krouse, Jay S. **"Movement, growth, and mortality of American lobsters, *Homarus americanus*, tagged along the coast of Maine."** September 1981. 12 p.

ABSTRACT

During the spring of 1975, 2,882 American lobsters, *Homarus americanus*, were tagged at three locations off Maine. Four months after release 65 percent of the lobsters had been returned and by the completion of the study in September 1977, 2,188 (75.9 percent) lobsters had been recaptured. Most returns (88 percent) occurred within a 5 n.mi. (9.3 km) radius of the release site and only about 1 percent of the recaptured lobsters had moved more than 10 n.mi. (18.5 km). Movement and catchability did not vary significantly by sex nor size. The majority of lobsters traveled shoreward or along the coast on a west to southwesterly course with minimal easterly movement. All long distance migrants (>20 n.mi. or 37.0 km) followed a south to southwesterly course. Extremely high annual instantaneous fishing mortality rates (4.0-7.3) estimated for each release area confirm the overexploitation of the Maine inshore lobster fishery.

NOAA Technical Report NMFS SSRF-748. Darcy, George H. **"Annotated bibliography of the conch genus *Strombus* (Gastropoda, Strombidae) in the western Atlantic Ocean."** September 1981. 16 p.

ABSTRACT

This bibliography consists of 126 annotated references on the anatomy, biology, behavior, distribution, ecology, economic uses, fisheries and fishing methods, mariculture, physiology, predators, symbionts, systematics, and toxicity of seven species of the conch genus *Strombus* in the western Atlantic Ocean. A subject index is provided.

NOAA Technical Report NMFS SSRF-749. Langton, Richard W., and Ray E. Bowman. **"Food of eight northwest Atlantic pleuronectiform fishes."** September 1981. 16 p.

ABSTRACT

The food of eight species of pleuronectid fishes, occurring in the northwest Atlantic, from Cape Hatteras, N.C., to Nova Scotia have been investigated for the years 1969-72. Gulf Stream flounder, *Citharichthys arctifrons*, are annelid and arthropod predators. Summer and fourspot flounders, *Paralichthys dentatus* and *P. oblongus*, prey on fish, squid, and arthropods. The diet of the windowpane, *Scophthalmus aquosus*, consists of arthropods with mysids, pandalid shrimp, and sand shrimp being especially important prey. Witch flounder, *Glyptocephalus cynoglossus*, are predators of benthic invertebrates, preying heavily on annelids. The primary prey of American plaice, *Hippoglossoides platessoides*, is echinoderms. Yellowtail flounder, *Limanda ferruginea*, are annelid and amphipod predators. Winter flounder, *Pseudopleuronectes americanus*, prey on annelids, coelenterates, and bivalve molluscs.

Puget Sound Fisheries, History, and Development

"The Water Link," by Daniel Jack Chasan, published by the Washington Sea Grant Program in Seattle, is the foundation for a series of 14 books commissioned to provide useful information about the physical properties and biological aspects of Puget Sound, man's use of it, and his relationships to this unique region of the Pacific Northwest.

This first volume is something of a history of the Puget Sound region and, as it must, deals in large part with the commercial and recreational fisheries of the Sound and the various facets of development that impinge upon them. In it, the author chronicles the rise of the salmon canning industry, water pollution problems, oyster farming, changes in salmon and steelhead fishing, and the Indian fishing rights controversies of recent years. The text concentrates on specific episodes that convey the character of each period from 1853 to the late 1970's. Other competing uses of the Sound woven into the text include logging, industrial development, paper production, railroads, labor disputes, and more.

The series has been supported by NOAA's Puget Sound Marine Ecosystems Analysis (MESA) Project, the Environmental Protection Agency, and the National Sea Grant Program. This volume is the first to describe the history of the Sound in terms of its historic development and environmental conflict. And if the rest of the series is as well written, the mission should be successful.

Indexed, the 192-page paperbound volume also contains a chronological table of historical data and bibliographic notes. It is well illustrated with historic photographs and maps, and is available from the University of Washington Press, Seattle, WA 98105 for $8.95 per copy.

Foreign Investment in U.S. Seafood Industry

Foreign investment in the U.S. seafood industry has increased in recent years,

but its extent and impact are uncertain. Some industry and public officials are concerned that dependency on foreign sources of capital is causing U.S. processors to lose control of the industry. Complete data on the extent of these investments is lacking, making analysis difficult.

Last year the U.S. General Accounting Office prepared a 74-page report entitled "Foreign Investment in U.S. Seafood Processing Industry Difficult to Assess" (CED-81-65). A copy of the report can be obtained free of charge by writing to: U.S. General Accounting Office, Document Handling and Information Services Facility, P.O. Box 6015, Gaithersburg, MD 20760.

Marine Game Fish and Their Records

The 1981 edition of **"World Record Game Fishes,"** published by the International Game Fish Association, continues to grow as a source of interesting and authoritative data for sportsmen and scientists interested in marine game fish and fishing.

Annually, it provides a list of the international angling rules, world record requirements, and IGFA fishing contest rules and winners. And each year it catalogs an ever increasing number of world record game fishes. This edition has added the freshwater line class and fly fishing world records for over 70 species for the first time, marking the establishment of the first comprehensive international program for freshwater recordkeeping. Altogether, over 140 fresh- and saltwater species are included. And, of course, the saltwater line class and all-tackle records have been updated. Some 17 freshwater species are new to the records listing, along with four new saltwater game species: tope, *Galeorhinus galeus*; European bass, *Dicentrarchus labrax*; cubrera snapper, *Lutjanus cyanopterus*; and conger, *Conger conger*.

It also contains new articles by noted fisheries scientists: C. Richard Robins outlines the formulation and use of common and scientific names of fishes; Robert J. Behnke explains fish hybridization and discusses its uses (or problems) in fishery management and fish records programs; and Harold H. Harvey describes the threat that acid rain poses to fish and fishing.

Noted outdoor writers Mark Sosin and Ken Schultz provide sound tips on angling photography and proper techniques for releasing fish unharmed, respectively, while master rod-builder Dale P. Clemens tells how to build a custom fishing rod.

To the standard text on marine game species, is added a guide to the salmonids and a synopsis of the tuna tribe. Appendices now include new data on game fish records of other nations and continents (heaviest catches recorded by major sportfishing organizations), a listing of the 50 state agencies providing angling information, and the guide to gamefish tag and release programs has been updated.

Other items include a rundown on the IGFA itself—its origin, philosophy, goals, and the Library of Fishes—plus a glossary of scientific and descriptive words, illustrations of the parts of fishes (and of the major saltwater sport fishes), fishing knot and splice instructions, conversion tables for weights and measures, and more.

The paperbound, 308-page volume is available from the IGFA, 3000 East Las Olas Boulevard, Fort Lauderdale, FL 33316 for $6.95 postpaid in North America and $8.50 in all other countries.

Sea Turtles in the Central West Atlantic

The Interregional Fisheries Development and Management Program, a component of the Western Central Atlantic Fishery Commission (WECAFC) has prepared a report entitled "The Status of Sea Turtles Stocks Management in the Western Central Atlantic." The Intergovernmental Oceanographic Commission Association for the Caribbean and Adjacent Regions (IOCARIBE), in cooperation with the United Nations Development Program, FAO, and Interregional Fisheries Development and Management program has initiated a regional research program on turtles. The program will culminate in a Symposium on Sea Turtle Research (Populations and Socioeconomics) in the Western Central Atlantic Region which will be held in Costa Rica this year.

This report was prepared as part of the presymposium activities to summarize existing information and to review limitations in current knowledge on sea turtles in the region. Arranged by country, the report includes data on the status, nesting and foraging areas, population estimates, sanctuaries, and legislation concerning Atlantic turtles. Copies can be obtained from D. A. Lintern, Acting Project Director, WECAFC, P.O. Box 6-4392, Estafeta, El Dorado, Panama.

Report on Swedish Fisheries in 1980

Both the quantity (220,000 metric tons) and the value ($95 million) of the Swedish fisheries catch increased during 1980 by approximately 16 and 10 percent, respectively, compared to 1979 levels. Substantial increases in the herring and cod catch contributed to this overall increase. Operating costs, however, have increased in 1980 and depressed earnings of Swedish fishermen and fishing companies. Freshwater fishermen face the problems of acidification of lakes and rivers and of competition from recreational fishermen. The expansion of the seafood processing industry has been undertaken in hopes of achieving self-sufficiency in this sector. It is also expected that the demand for fish intended for human consumption will increase as a result of the anticipated Government move to reduce or abolish subsidies for meat which will increase its price.

The U.S. Embassy in Stockholm has prepared a 16-page report on Swedish fishery developments during 1980. A copy of this report can be ordered for $5.00 by requesting report number PB-81-226-318 from the U.S. Department of Commerce, NTIS, Springfield, VA 22161.

Editorial Guidelines for *Marine Fisheries Review*

Marine Fisheries Review publishes review articles, original research reports, significant progress reports, technical notes, and news articles on fisheries science, engineering, and economics, commercial and recreational fisheries, marine mammal studies, aquaculture, and U.S. and foreign fisheries developments. Emphasis, however, is on in-depth review articles and practical or applied aspects of marine fisheries rather than pure research.

Preferred paper length ranges from 4 to 12 printed pages (about 10-40 manuscript pages), although shorter and longer papers are sometimes accepted. Papers are normally printed within 4-6 months of acceptance. Publication is hastened when manuscripts conform to the following recommended guidelines.

The Manuscript

Submission of a manuscript to *Marine Fisheries Review* implies that the manuscript is the author's own work, has not been submitted for publication elsewhere, and is ready for publication as submitted. Commerce Department personnel should submit papers under completed NOAA Form 25-700.

Manuscripts must be typed (double-spaced) on high-quality white bond paper and submitted with two duplicate (but not carbon) copies. The complete manuscript normally includes a title page, a short abstract (if needed), text, literature citations, tables, figure legends, footnotes, and the figures. The title page should carry the title and the name, department, institution or other affiliation, and complete address (plus current address if different) of the author(s). Manuscript pages should be numbered and have 1½-inch margins on all sides. Running heads are not used. An "Acknowledgments" section, if needed, may be placed at the end of the text. Use of appendices is discouraged.

Abstract and Headings

Keep titles, heading, subheadings, and the abstract short and clear. Abstracts should be short (one-half page or less) and double-spaced. Paper titles should be no longer than 60 characters; a four- to five-word (40 to 45 characters) title is ideal. Use heads sparingly, if at all. Heads should contain only 2-5 words; do not stack heads of different sizes.

Style

In style, *Marine Fisheries Review* follows the "U.S. Government Printing Office Style Manual." Fish names follow the American Fisheries Society's Special Publication No. 12, "A List of Common and Scientific Names of Fishes from the United States and Canada," fourth edition, 1980. The "Merriam-Webster Third New International Dictionary" is used as the authority for correct spelling and word division. Only journal titles and scientific names (genera and species) should be italicized (underscored). Dates should be written as 3 November 1976. In text, literature is cited as Lynn and Reid (1968) or as (Lynn and Reid, 1968). Common abbreviations and symbols such as mm, m, g, ml, mg, and °C (without periods) may be used with numerals. Measurements are preferred in metric units; other equivalent units (i.e., fathoms, °F) may also be listed in parentheses.

Tables and Footnotes

Tables and footnotes should be typed separately and double-spaced. Tables should be numbered and referenced in text. Table headings and format should be consistent; do not use vertical rules.

Literature Citations

Title the list of references "Literature Cited" and include only published works or those actually in press. Citations must contain the complete title of the work, inclusive pagination, full journal title, the year and month and volume and issue numbers of the publication. Unpublished reports or manuscripts and personal communications must be footnoted. Include the title, author, pagination of the manuscript or report, and the address where it is on file. For personal communications, list the name, affiliation, and address of the communicator.

Citations should be double-spaced and listed alphabetically by the senior author's surname and initials. Co-authors should be listed by initials and surname. Where two or more citations have the same author(s), list them chronologically; where both author and year match on two or more, use lowercase alphabet to distinguish them (1969a, 1969b, 1969c, etc.).

Authors must double-check all literature cited; they alone are responsible for its accuracy.

Figures

All figures should be clearly identified with the author's name and figure number, if used. Figure legends should be brief and a copy may be taped to the back of the figure. Figures may or may not be numbered. Do not write on the back of photographs. Photographs should be black and white, 8- × 10-inches, sharply focused glossies of strong contrast. Potential cover photos are welcome but their return cannot be guaranteed. Magnification listed for photomicrographs must match the figure submitted (a scale bar may be preferred).

Line art should be drawn with black India ink on white paper. Design, symbols, and lettering should be neat, legible, and simple. Avoid freehand lettering and heavy lettering and shading that could fill in when the figure is reduced. Consider column and page sizes when designing figures.

Finally

First-rate, professional papers are neat, accurate, and complete. Authors should proofread the manuscript for typographical errors and double-check its contents and appearance before submission. Mail the manuscript flat, first-class mail, to: Editor, *Marine Fisheries Review*, Scientific Publications Office, National Marine Fisheries Service, NOAA, 7600 Sand Point Way N.E., Bin C15700, Seattle, WA 98115.

The senior author will receive 50 reprints (no cover) of his paper free of charge and 100 free copies are supplied to his organization. Cost estimates for additional reprints can be supplied upon request.

☆GPO 1981 593-043

UNITED STATES
DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL MARINE FISHERIES SERVICE
SCIENTIFIC PUBLICATIONS OFFICE
BIN C15700
7600 SAND POINT WAY N.E.
SEATTLE, WA 98115

OFFICIAL BUSINESS

POSTAGE AND FEES PAID
U.S. DEPARTMENT OF COMMERCE
COM-210

Second Class

U.S. MAIL

MFR UNIVM300UFISSDUE004R 1 *
UNIV MICROFILMS INTL *
SERIALS PROCESSING *
300 N ZEEB RD *
ANN ARBOR MI 48106 *